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ON THE CAPRICIOUS HEARING OF CERTAIN SOUNDS AT LONG RANGE.

By the Rev. JOHN M. BACON, F.R.A.S.

THE last has hardly yet been said as to the vagaries of sounds of long range. Dr. Davison has contributed to KNOWLEDGE* a graphic record showing how at a great many distant places the minute guns fired at Spithead on February 1st were distinctly audible; some of these places, mainly lying to the N., being upwards of a hundred miles away—while at the same time the sound waves in the immediate neighbourhood of Spithead were almost or quite imperceptible. Commenting on this, Dr. Davison conceives that the sound waves were first of all reflected by contrary winds over the heads of observers, but were afterwards brought down again by favourable upper currents. The same authority states that the report of guns, distant or otherwise, when inaudible in Portsmouth or Winchester, may often be distinctly heard from the more open or higher ground outside these towns.

* KNOWLEDGE, June, 1901.

The bending upwards or downwards of sound waves, which seems to have presented a problem to Sir John Herschell, has been explained by Sir G. Stokes as due to the general increase of the velocity of wind currents with height above the ground. As a consequence of this he maintains that the front of a sound wave moving against the wind will be caused to lean backwards and therefore its direction of motion to be tilted obliquely upwards. Tyndall accepting this theory, and taking a hinged ladder out on to a common, satisfied himself that a small bell which had been moved to leeward until its sound was inaudible could be distinctly heard when he climbed high enough to catch the sonorous waves that were being deflected upwards.

It is here that I would offer a few observations of my own as mainly supporting the above. On one occasion, when making a balloon ascent from Newbury, I caused the tenor bell of Thatcham Church, weighing upwards of a ton, and distant scarcely three miles to windward, to be set ringing as in peal. The wind was a light breeze, and the balloon maintained altitudes varying between 1000 and the 3000 feet, yet the bell was inaudible to each and all of the four observers in the car. It is true that for the first few minutes there was much noise in the air occasioned by the shouting of the crowd, but afterwards we travelled only over quiet agricultural country. Another noteworthy phenomenon, to prove which there is abundant evidence, is that when fog-signals are being fired from the Bishop lighthouse these will sometimes sound so loudly in the lower part of Hugh Town and Porth Cressa at St. Mary's Island, eight miles away, as actually to shake the houses, while the reports may be scarcely audible from the high and open ground above. Once again I may mention that the guns which, as Dr. Davison states, were unheard at Newbury, forty-four miles away in low ground, were also inaudible from my own grounds in the neighbourhood, which are nearly 500 feet above sea-level. In the above cases due account must of course be taken of any local turmoil in the air which may have tended to mask the distant sounds. In proof of this I may give a recent experiment. A powerful reed was blown at the focus of a large paraboloidal shell, the open mouth of which was directed towards distant clumps of trees in full foliage, when echoes were returned lasting for as much as seven seconds, there being an absence of wind at the time and the summer night well advanced. Other things being equal, however, the same echoes were lost after four or five seconds if there were but faint sounds in the air such as those of bird or insect life. This is tantamount to proving that a local disturbance which is scarcely noticeable may reduce the range of a given sound by almost one-half.

Further, it may be a question whether the nature of the earth may not in some way affect long hearing. Bearing on this, Lord Rayleigh makes the suggestive remark: "The propagation of earthquake disturbance," he says, "is probably affected by the curvature of the surface of the globe acting like a whispering gallery, and perhaps even sonorous vibrations generated at the surface of land or water do not entirely escape the same kind of influence."

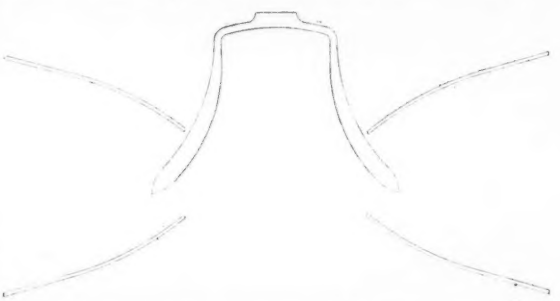
Again, surrounding country may make a vast difference in redoubling a sound at any given point or else in allowing it to escape. A remarkable instance of this came under my notice lately. For signalling purposes I was firing gun-cotton fog-signals on the open ground at Cheetham Hill, Manchester, between ten and

eleven p.m. These service signals are uniform in character, and the first, though of the usual intensity, was followed by little after-sound. After an interval occupied only by the burning of two distress signals another gun-cotton charge was fired from within a yard or two of the same spot, the reverberations of this, however, were so peculiar and prolonged as to disturb the neighbourhood. If the great difference of after-sound was not due to the slight alteration of position, it can only be referred to the fact that the first cartridge was fired eighteen inches above the ground, while the second was laid on the hard earth, in which it blew a deep cavity.

With reference to the far hearing of bells one most important statement to make is that their sound is extremely uncertain. Seamen, lighthouse keepers and others, whose training makes them close observers, constantly insist on this. I have already shown how remarkably the sound of a bell may be lost in the free upper air. Against this may be quoted a statement which I have on the authority of Messrs. Mears, the well-known bell-founders. It appears that the tenor bell of the peal of St. Bees, on the coast of Cumberland, has been heard at the top of Scafell Pikes, sixteen miles distant in a straight line. This is certainly a record, and must probably be largely accounted for by the slope of the mountain. My own experience is wholly against the possibility of the hearing of a deep bell across such distance and at the height of 3000 feet in the free heaven. The story of the sentry on duty on the terrace of Windsor Castle suspected of drowsiness and yet detecting the clock bell of St. Paul's striking thirteen is quite incredible to one who has frequently and from chosen places of advantage listened to the clocks of London striking midnight. To begin with, hundreds of other clocks are striking at the same period, and for anyone to accurately count out the strokes of any particular bell would require that observer to be very wide awake indeed, and certainly at a nearer distance than twenty odd miles. But a very interesting and instructive series of observations relative to the hearing of a bell heavier by ten tons—namely, Big Ben—has been contributed to the *Quarterly Journal of the Roy. Met. Soc.* by Mr. William Marriott. This observer, making careful note twice daily from a station in West Norwood, only five and a half miles away, records that the bell was very distinctly heard four times, faintly heard 64 times, and altogether unheard on 251 occasions. A significant comment is added to the effect that the most favourable hours were those of evening and Sundays.

Where a bell is chosen for a warning signal, *e.g.*, as on a lighthouse, and it is desired that its sound be carried in all directions over as great horizontal ranges as possible, the most efficient form of sound-board will be found to be that shown in the accompanying figure. Here it will be seen by taking any vertical section of the apparatus that every point on the sound-bow of the bell (*i.e.*, that zone that is in most intense vibration) virtually occupies the focus of a parabolic reflector, and thus the principal sound waves are made to travel outwards horizontally in parallel rays.

An approximation to the paraboloid will be found the best possible form for instruments designed alike to convey and receive the human voice at long range. Obviously some little compromise in outline will be necessary. The aperture of the ear in listening, as also the lips in speaking, should, as nearly as possible, occupy the focus of each instrument. Thus it is clear that the *latus rectum* should not much exceed $1\frac{1}{2}$ inches, and it will then be found convenient that the larger end of the instrument (which may measure some 14 inches in length) should be somewhat constricted so as to approach a cylindrical form. With a pair of these instruments, forming respectively a giant speaking trumpet and a giant ear, speech can be carried on across an open common on a quiet night over a mile range. Any appreciable amount of wind stirring affects results greatly. A favouring wind scarcely favours the hearing of the voice, doubtless largely owing to the murmur in the air caused by the wind stirring the herbage, etc.



It may be otherwise in the case of a gun. Dr. Davison considers that presuming the velocity of wind to increase with height the report of a gun might be audible at a much greater distance in wind than in calm. Tyndall points out that in wind a gunshot may readily be lost altogether, but states as an observation of his own that on a windy day a gun was heard five times and might probably have been heard fifteen times, as far to leeward as to windward.

It has been suggested that the peculiar loudness of some of the reports heard on February 1st may have been due to the discharge of several guns at practically the same instant. This argument may be valid enough in the case of independent but simultaneous gun firing, but it is only true in a very modified degree in the case of the usual gun-cotton fog-signals already spoken of, and chosen by the service for special penetration. The explosion of an eight-ounce cartridge is certainly not nearly twice as loud as that of four ounces, while through interference or some other cause the firing of two four-ounce cartridges in juxtaposition is not very greatly louder than that of one. On an occasion when experimenting on echoes I was firing a number of these fog-signals singly from the clouds I designed to make a superlative discharge by firing a nest of many united together. It chanced that I was able to explode this giant bomb nearly over the racecourse at Epsom at an altitude of about half a mile, the course was deserted, but the nature of the ground seemed favourable for a grand effect. I can but state, however, that the resulting report and subsequent echoes were under the circumstances disappointing.

THE INSECTS OF THE SEA.—V.

By GEO. H. CARPENTER, B.SC.(LOND.), *Assistant in the Museum of Science and Art, Dublin.*

FLIES.

TWO-WINGED flies are perhaps the most dominant of all insects. The woodland rambler in summer-time knows too well what swarms of flies hover with ceaseless

buzzing around his head. The individuals of some one kind often occur in countless numbers, and when the flies, now somewhat neglected, have been thoroughly studied, it is likely that their species will be found to exceed in number those of any other insect-order, not excepting even the beetles. Certainly the naturalist who goes to look for insects by the sea-shore in summer-time will first of all be struck by the great abundance of various kinds of flies. He needs not to search for them, as for beetles or springtails, beneath stones; they fly and run to and fro in the sunshine with ceaseless activity.

Among these insects the remarkable modification of the wings of the hind pair into small stalked knobs or "balancers" (*halteres*) leaves the fore-wings alone functional as organs of flight. This character marks the flies as a very distinct order of insects, and suggests for them the expressive name of "Two-wings" (Diptera). In many points of structure flies are the most highly organised of all insects, and their great specialization of form is matched by a great complexity in the transformations that they undergo. The most highly developed members of the order begin life as degraded, headless, legless maggots. The skin of the full-fed maggot hardens to form a brown, egg-shaped puparium, within which first the pupa and then the perfect fly is built up by a profound dissolution and reconstruction of the larval tissues and organs. The despised housefly and blue-bottle are proclaimed therefore by their structure and life-history to belong to the highest aristocracy of the insect-world.

Out in the open air one may meet with many hundreds of different kinds of flies more or less related to our well-known guests just mentioned. A vast number of these, which differ from the blue-bottle and its immediate allies in the absence of the silvery scales at the base of the wings, are often spoken of collectively as the "Acalypterata." Quite a little assemblage of these insects haunt the shore just above high-water mark, finding in the cast-up seaweed a playground for themselves, and a feeding-place for their offspring. They are very nearly related to the bright yellow, hairy, red-faced flies of the genus Scatophaga, which may be observed any sunny day in vast numbers hovering over dung-heaps. *Fucellia fucorum* (Fall.), the closest ally of Scatophaga among them, is a small, inconspicuous ashy fly, common on our coasts, and ranging along the western and southern edge of the Continent from Norway to the Adriatic. One other species of Fucellia inhabits our shores, but there are seven or eight

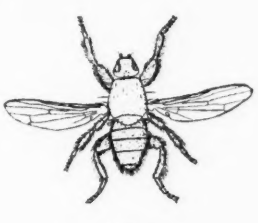


FIG. 1.

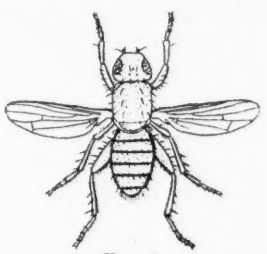


FIG. 2.

FIG. 1.—*Coelopa pilipes*, male. Magnified 3 times.

FIG. 2.—*Orygma luctuosa*, male. Magnified 3 times.

different kinds known from the far north of the Scandinavian peninsula—Lapland and Finmark. The flies belonging to Coelopa (Fig. 1) and its allied genera have a most characteristic aspect with their narrow, angular heads, small eyes, and flattened, depressed bodies. They all have stout and powerful legs, which in some species are armed with a most formidable array of spines, while in others they are clothed with a dense setting of long, woolly hairs. The distribution of Coelopa is remarkable. Five or six species inhabit the British and Irish coasts, of which most have been traced to Scandinavia, but only one or two range southwards to Holland and Heligoland, so that the genus is characteristically north-western. Of similar distribution and habits is *Orygma luctuosa*, Meig. (Fig. 2), a somewhat larger fly than the Coelopæ, and distinguished from them by its broad, rounded head.* *Actora aestuum*, Meig., is a still larger fly of an ashy grey colour, less differentiated from related insects than are its comrades of the sea-shore. It is of especial interest since its grub has been described,† and proves to be a greyish maggot with wrinkled skin, fourteen prominent, conical, fleshy processes surrounding the air-openings at the tail-end.

This assemblage of flies, some of whose leading members we have briefly sketched, though few in species, is often very numerous in individuals. On a sunny day, when the tide is high, the observer has but to lie on the beach to watch the ceaseless darting flight of the insects over the seaweed-heaps. Many of the flies follow the receding waves, so that at low-water they may be seen running over the recently exposed rocks or alighting after a short flight on the still damp seaweed.

Many very small flies, belonging to the same great group as those just considered, but to a most distinct sub-family, the Ephydrinæ, also haunt the sea-shore. As usual, a transition can be traced from marsh-dwelling species to those which cling to the tidal margin. Thus the tiny *Atissa pygmaea*, Halid. lives in salt marshes. *Tichomyza fusca*, Macq. is found both on chalky coasts at high-water mark and in the sewers and outhouses of large towns, its grub feeding on decomposing limy material. *Glenanthe ripicola*, Halid. (Fig. 3) dwells on muddy sea-coasts, while nearly all our native species of Scatella live among the seaweed masses

FIG. 3.

FIG. 4.

FIG. 3.—*Glenanthe ripicola*, male. Magnified 8 times. (After Haliday.)

FIG. 4.—*Chersodromia arenaria*, male. Magnified 12 times.

* *See* J. R. Schiner. "Fauna Austriaca, Diptera." Wien, 1861-4. F. Walker [& A. H. Haliday]. "Insecta Britannica, Diptera." 3 vols. London, 1851-6. G. H. Verrall. "A List of British Diptera." London, 1888.

† H. Gadeau de Kerville. "Notes sur les Larves Marines d'un Diptère." *Ann. Soc. Ent. Fr.* (Vol. LXIII.), 1894, pp. 82-5.

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thrown up by the tide. Two most remarkable members of this group have been found by the Rev. A. E. Eaton on the shores of the far southern island of Kerguelen.‡ One—*Anomalopteryx maritima*, Eaton, with narrow strap-like wings, haunts the nests of sea-birds; while the other, *Apetenus litoralis*, Eaton, creeps over the stones of the beach.

Several small flies of prey belonging to the family Empidae may be found on our coasts, often occurring in great companies. Though this family is structurally far removed from the groups mentioned above, the sensitive bristle of the feeler, for example, being borne at the tip, not on the edge of the terminal segment, and the grub possessing a distinct head—Haliday pointed out the likeness to Coelopa in the general aspect of these marine Empids. The most characteristic of them belong to the genus Chersodromia. Perhaps the most noteworthy species is *C. arenaria*, Halid. (Fig. 4), in which the wings are so shortened as to be useless for flight—a character, as we have seen, rather frequent among the insects of the sea-shore. Apparently this genus occurs only on our islands and the Scandinavian coasts.

Another family represented on the sea-shore whose members live by prey is the Dolichopodidæ. These are slender, agile flies, often of bright blue or green metallic colours; they are very numerous in species, and often haunt the margins of lakes and streams, running over the surface of the water in pursuit of their prey. Some of the more daring members of this family live close to the edge of the sea within reach of the spray of the breakers, and find their victims in the weaker insects of the shore. Several of the large genera such as Dolichopus and Hydrophorus have each a few maritime representatives, while Machaerium, with only one species—*M. maritimæ*, Halid.—seems to be confined to seaside marshes, and Thinophilus and Aphrosylus (Fig. 5) each with two or three species are only to be

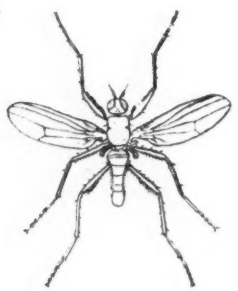

FIG. 5.

FIG. 6.

FIG. 5.—*Aphrosylus raptor*, male. Magnified 3 times. (After Westwood.)

FIG. 6.—Grub of *Aphrosylus*. Magnified 12 times. (After Wheeler.)

found close to the edge of the water, occurring on rocks and seaweed washed by the waves. The species of Thinophilus are bronzy in aspect, but the Aphrosyli have the ashy grey hue characteristic of so many sea-shore insects. The specific names *raptor* and *ferox*, bestowed on them by their describer, A. H. Haliday, sufficiently indicate their habits. For many years Aphrosylus was known only on the British, Irish, and Italian shores, but quite recently three species have been discovered on the Pacific coast of North America by Prof. Wheeler,§ who was fortunate enough to find the curious grub of one of them (Fig. 6) among the seaweed covering the rocks.

But the most perfectly adapted to marine life of all the flies of the sea-shore are minute in size, and belong to one of the lowliest families of the order—the Midges or Chironomidæ. Though small, these are among the most familiar of insects; they may often be seen on a summer evening flying in swarms over the waters of ponds and streams in which their grubs live. The best known species of the family, *Chironomus plumosus*, and its burrowing red grub the "blood-worm," together with some allied forms have been lately described in detail by Miall and Hammond.‖ The Chironomidæ are readily to be distinguished from the gnats or mosquitoes (Culicidæ) by the great reduction of the jaws, which renders them incapable of biting and by the simplicity of the wing-neuration.

One or two species of Chironomus haunt the rocks exposed at low-tide, and their grubs live in the sea as happily as the grubs of their relations live in fresh water. Prof. Miall has found that the fresh water larvæ cannot long survive transference to salt water. Possibly by gradually increasing the degree of salinity, acclimatisation might be brought about in the lifetime of an individual, but there can be no doubt that in the course of generations these marine midge-grubs have become well-used to their strange surroundings. One of them which has been dredged off our coasts from a depth of 15 fathoms was described in the first instance as a marine annelid under the name of *Compontia cruciformis*. Except in its colour, which is appropriately a light sea-green, this creature closely resembles an ordinary "blood-worm," possessing a pair of sucker-feet at either end of its body, and tubular "blood-gills" on the two hindmost segments. Mr. Swainson has lately found this grub on hydroids at various parts of the British coast.¶ It may perhaps prove to belong not to a Chironomus in the strict sense, but to the closely allied genus Thalassomyia (which possesses but one species, *T. Frauenfeldii*, Schiner) distinguished by the short, broad, and emarginate fourth tarsal segment. On the shores of the Adriatic, this midge was found sitting on rocks within reach of the spray, and it has been noticed on the coast of the Isle of Wight in a somewhat similar situation resting on the walls of a cave, where the spray constantly washed over it.

Marine midges have been found on the other side of the Atlantic. A grub dredged from the depth of 20 fathoms off the coast of Massachusetts and its parent fly were described by Prof. Packard** in 1869 under the name of *Chironomus oceanicus*. As might be expected they have not escaped the notice of French naturalists. In 1892, Prof. Moniez described a marine Chironomus from the shores of the Channel remarkable

‡ G. H. Verrall. "Zoology of Kerguelen Island, Diptera." *Phil. Trans. R. Soc.*, Extra Vol. CLXVIII., 1879, pp. 238-48.

§ W. M. Wheeler. "A Genus of Maritime Dolichopodidæ new to America." *Proc. Cal. Acad. Sci.* (3) Vol. I; 1897, pp. 145-152, pl. 4.

‖ L. C. Miall & A. R. Hammond. "The Structure and Life-History of the Harlequin Fly (Chironomus)." Oxford, 1900.

¶ *See* F. V. Theobald. "An Account of British Flies," Vol. I. (pp. 202-3). London, 1892.

** A. S. Packard. "On Insects inhabiting Salt Water." *Proc. Essex Inst.* (Salem, Mass.), Vol. VI., 1869, pp. 41-51.

in the great divergence between the two sexes, the male having the usual facies of his genus, while the female in some respects seems to approach Clunio—perhaps the most characteristically marine member of the whole order.

The male (Fig. 7) of *Clunio marinus* was described††

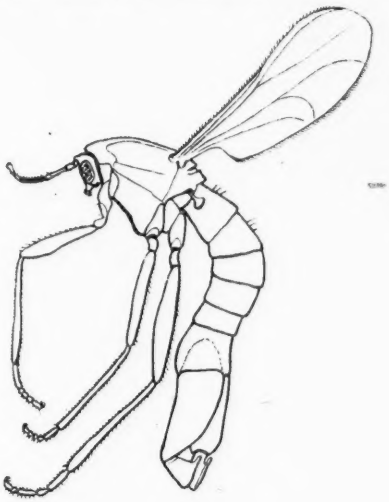

FIG. 7.

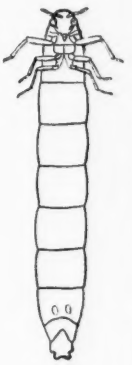

FIG. 8.

FIG. 9.

FIG. 7.—*Clunio marinus*, male (side view). FIG. 8.—Female (under view). FIG. 9.—Larva (side view). Magnified 24 times.

forty-six years ago by that admirable Irish entomologist A. H. Haliday, who found the insect in Co. Kerry "on gravelly sea-coasts below high-water mark, walking with the wings half-raised, and in rapid vibration without taking flight." Clunio is readily distinguished from Chironomus by the degeneration of the jaws being carried to an extreme point; only four minute hairy tubercles, representing apparently the lobes and palps of the second maxillæ, can be made out. The eleven-segmented feelers of the male are most characteristic in form; the head is almost entirely hidden beneath the great hood-like forebody shield, while the hinder end of the insect seems disproportionately large owing to the immense size of the genital claspers. This midge is only about 2 mm. long.

"I have observed the insects," wrote Haliday, "only in blustery weather, and could not find any trace of the female among them." She escaped observation indeed for well-nigh forty years; then in 1894 descriptions of her were published almost simultaneously‡‡ by M. René Chevrel, who had been diligently studying the species along the rocky coasts of Calvados, and the present writer, who met with a colony on the shores of Killiney Bay, Co. Dublin. The female Clunio (Fig. 8) is wingless and degraded—almost worm-like with her elongate and (when full of eggs) swollen hind-body, her short and feeble legs, her feelers with only seven reduced segments, and her small eyes.

According to M. Chevrel's observations, Clunio can only be observed during the low spring tides. "One only begins to see them," he writes, "when the rocks where they dwell are uncovered. Few in number the first day, they abound on the morrow and the two following days. Then, becoming scarcer and scarcer, they disappear completely towards the sixth or seventh day, not to be seen again till the next syzygy." Thus periodically they appear from April till October. The males are very active, moving over the rocks and the seaweed—frequenting especially the masses of the bright green Cladophora—or skimming across the surface of the rock-pools. They are in search of the females who creep slowly about among the seaweed. When mating takes place, the male seizes the female with his powerful claspers, holding her by the last abdominal segment, and carries her away with him, her body being almost in a line with his, and her feet, clear of the surface whereon he is walking, kicking in the air. "He takes her about thus for an hour," states M. Chevrel, "then he places her on a rock or an alga. The female, being freed, walks slowly for some minutes, and chooses a suitable spot to lay her eggs. . . . She applies the tip of her abdomen to the rock or seaweed and fixes thereto a gelatinous, cylindrical tube wherein the eggs are lodged." These number from 50 to 120. "When the operation is finished, the female, exhausted by the efforts which she has made, can only move slowly; she walks painfully, stops often, and only regains a little strength after resting for several minutes; then she wanders at random and ends by falling into the water, and, floating on the surface, waits for death, which is never long delayed." Often her feet become caught in the gelatinous substance of her egg-tube; she fails to disengage herself and dies resting on her eggs. "The male who has fertilised her," writes M. Chevrel, with a fine appreciation of this little drama of love and death, "does not forsake her; he stays near while the eggs are being laid, then, as if he knew his duty as husband or father, he throws himself upon her to rescue her from the sticky substance, or to carry her with her eggs to a more favourable place for the hatching of the offspring. Sometimes he falls himself a victim to his devotion and dies beside his mate, taken in the same snare."

The shrinkage of the female's body after the eggs have been laid is most remarkable. The degradation of the jaws in both sexes is such as to render feeding impossible, so that Clunio is an excellent example of those insects in which there is a complete division of labour between the larval and perfect stages of the life-history, the former only being concerned with feeding, and the latter entirely devoted to reproduction. The life of Clunio as a midge is therefore very short. M. Chevrel could find no trace of them after the tide had covered their breeding-places, and doubts whether they survive either by coming to the surface, or by seeking shelter below. But as he was able to keep specimens alive for 36 hours in captivity, it is likely that they survive from one low tide till the next—especially as a Clunio was discovered in the Adriatic at Trieste among submerged colonies of mussels.

The larva of Clunio is hatched about a week after the eggs are laid, being then only ½ mm. long, whitish and partly transparent. The full-grown larva (Fig. 9)

†† A. H. Haliday. "Descriptions of the Insects figured, &c." *Nat. Hist. Rev.*, Vol. II., 1858 (*Proc. of Soc.*, p. 62).

‡‡ R. Chevrel. "Sur un Diptère Marin du Genre Clunio." *Arch. Zool. Exp Gen.* (3) II., 1894, pp. 583-598. G. H. Carpenter. "Clunio marinus, a Marine Chironomid." *Ent. Mo. Mag.*, Vol. XXX., 1894, pp. 129-30. J. J. Kieffer. "Description d'un Diptère sous marin." *Bull. Soc. Ent. France*, 1898, pp. 105-8.

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is of a bright green colour, resembling closely that of the Cladophora, among which it lives. The well-developed head with strong mandibles working at an angle against the serrated labial plate, is succeeded by twelve body-segments whereof the first and last bear paired false feet armed with circles of hooklets. Special breathing organs like the gills of a Chironomus-larva are absent; this grub evidently breathes the dissolved air over the whole surface of the skin, a method of respiration common among very small aquatic insects.

Among the insects found by Mr. Eaton on Kerguelen Island is a female midge which resembles Clunio in some particulars. The body is elongate and worm-like, and the wings are reduced to small vestiges, but the legs are relatively very long and the hind-body ends in a pointed ovipositor (Fig. 11). This southern Chironomid —*Halirytus amphibius* is its name—was found "at the verge of the tide, creeping over Enteromorpha and mussels exposed by the recess of the sea, and walking upon the surface of puddles and tide-pools. The fly was common upon some small isolated rocks which were always submerged at high water. The adults in that locality must spend a large portion of their lives under water. Probably whenever the water has retired sufficiently from the top of the rocks, all the flies hurry up from below to take an airing."

Another tiny marine midge (Fig. 10) has lately been

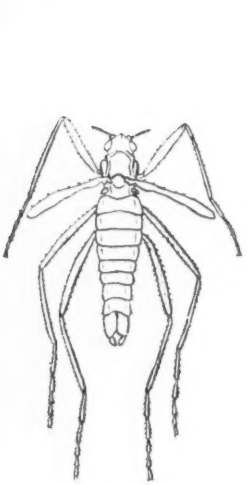

FIG. 10.

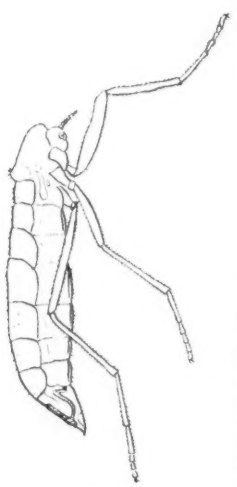

FIG. 11.

FIG. 10.—*Eretmoptera Brownii*, male. Magnified 15 times. (After Kellogg.)

FIG. 11.—*Halirytus amphibius*, female. Magnified 12 times. (After Eaton.)

discovered on the rocky coast of California, and named *Eretmoptera Browni* by Prof. Vernon L. Kellogg.§§ On account of its very remarkable structure its describer considers it the type of a distinct family. In both sexes the wings are "narrow and strap-like and wholly without veins . . . not specially thin or delicate, but rather thickened." The hind-wings, instead of being the stalked knob-like "balancers" usual among the Diptera, "are minute scale-like processes appearing like rudiments of wings" of the ordinary type. It is possible, therefore, that this midge may represent a very early stage in the evolution of the Diptera, before the characteristic "balancers" had become specially modified. "The flies, of which there were many, were resting or running on the surface of the ocean water of tide-pools, and had a tendency to gather in large numbers in patches and in ball-like masses on the water." The discovery of this most remarkable midge shows what wonders of insect life may still await the diligent observer by the sea-shore.

Reviewing generally the marine flies here briefly sketched, it will be noticed that they show a strong tendency towards the reduction or total loss of their wings. It will be remembered that a similar tendency is found among the marine beetles, but the flies are such typically aerial insects that loss of flight among them is especially remarkable. In a well-known passage Dr. A. R. Wallace|||| has pointed out that the insects inhabiting oceanic islands are often flightless, and he explains this as due to the action of natural selection; when flying individuals are liable to be blown out to sea, it becomes a positive advantage to the species to lose the power of flight. This state of things seems to be carried to an extreme on the far-off wind-swept island of Kerguelen. There can be little doubt that life by the sea-shore is rendered safer for insects, when through loss of the power of flight, they have ceased to expose themselves to the full power of the wind. And thus the degradation which they have undergone is the price of a more perfect adaptation to the strange surroundings which their ancestors chose long ago.

§§ V. L. Kellogg. "An Extraordinary New Maritime Fly." *Biol. Bulletin*, Vol. I., 1900, pp. 81-7.

|||| A. R. Wallace. "Darwinism." 2nd Edition (pp. 105-6). London, 1889.

ROUND FAIR HEAD.

By GRENVILLE A. J. COLE, M.R.I.A., F.G.S.

THE north-east of Ireland is essentially the land of Scots. From the third to the sixth century, its enterprising sons went forth, ran their light curraghs into the harbours of North Britain, held their own in that rugged country, and gave their name to Scotland. In the sixteenth century, the MacDonnells of the Isles, thirsting for a wider empire, returned to their ancient homes in the valleys that cut the Antrim plateaux, and sought to establish themselves amongst the Irish, who had almost forgotten the relationship. These Scots, indeed, had to win back the land which their ancestors had forsaken, and they form a population between Ballycastle and Cushendall, Scottish and distinct, still preserving the old religion, which was common to all at the time of their return.

In the midst of their territory rises the promontory of Benmore, Fair Head, as the English have called it, a worthy opponent to the great headland of Kintyre, which faces it fourteen miles away across the sea. There is no more distinctive feature in the county of Antrim than this sheer cliff-wall, with the rugged talus at its foot, a buttress to the coast, a defiance to the northern storms.

From Ballycastle on the west to the woods of Murlough Bay upon the east, the great crag dominates the landscape. Its essential characters become best revealed if we approach it from Ballycastle Bay.

South of us, on the broad dome of Knocklayd (Cnocleithid), we have an epitome of the most momentous phases of the geological history of Co. Antrim. The base of the hill consists of old micaceous schists, rocks

that have been squeezed and uptilted at a very early period. They are contemporary with the central masses of the Grampians. But above them runs a level band of chalk, encircling Knocklayd, with, above that again, up to the summit, 1700 feet above the sea, the brown-black basalts that are so familiar throughout Antrim and the western isles of Scotland.

The "white limestone," or chalk, is a relic of the material that once stretched across the country, deposited as fine ooze by the organisms of the Cretaceous sea. The sea-floor was raised by the mysterious and recurring earth-movements; the chalk became attacked by rain and rivers, and was converted into grassy downs, such as we see to-day in south-east England. Then, in what are called Eocene times, volcanoes broke out all across the area;* stream after stream of lava was poured over the blackened downs, filling up the hollows, choking the valleys, and finally burying the older features in continuous sheets of basalt. In our own times, these sheets have given rise to the high plateaux of the north, just as they form the tablelands of Trotternish in Skye and of the west of Mull, intersected here and there by ravines and valleys, into which their *débris* are swept down. Knocklayd is an outlying mass, cut off from the main plateaux by denudation, and forms a fitting introduction to the story of Fair Head itself.

We leave the blown sand that gathers in Ballycastle Bay, and before us rises the long wall of cliffs, culminating in the sharply defined crest of Benmore, a columnar façade erected, as it were, by titans. Yellow and grey sandstones, cut here and there by dykes of basalt, flank our route at first; and then we come unexpectedly on a little coal-mine, burrowing into the face of the cliff, and bringing out its black heaps against the road. We have here, in fact, the same strata, low down in the Carboniferous system, as those in which coal is successfully worked near Edinburgh. Further on, where the road becomes a mere track, climbing above slopes of grass, we find the yellow sandstone worked in a high quarry, from which the crane lowers the blocks for shipment at a tremulous pier. It is odd to note here the coal-seams exposed upon the natural surface of the cliff, and showering down their black detritus on the pathway. On our left, across five miles of gleaming water, Rathlin Island smiles in sunlight, its strip of chalk capped by a basalt layer, a mass detached from Antrim by the wash of waters round it.

It was my fortune thus to view it on the third of January in the present year, one of those fresh and brilliant days that are far more common in a highland winter than we realise among the fogs of towns. There certainly was nothing to suggest the bitter tragedies of 1575, the slaughter of enfeebled Scots up and down the plateaux, the relentless hunting of women and children through all the white caverns on the shore.

And now the path rises further, up the side of a waterfall, which comes leaping down the flank of Sronbane, a projection perhaps named from its contrast with the sterner mass beyond. The foot-track is for us no longer; we must take to the slopes of grass, and trust to our wits to bring us round.

Half-a-mile further, the first blocks of basalt cumber the ground; above us we see the sandstones seamed with horizontal sheets of lava, which have worked their way in between them, baking them as they went. These are the offshoots of the great volcanic knot of Fair Head, a huge intrusion of molten matter, now cold and crystalline, which forced its way in among the older rocks during the earth-storm that once raged in Antrim. Those who know Staffa or the Giant's Causeway will recognise the volcanic rocks above us now. The sheets have shrunk on cooling, have cracked transversely, and a range of columns results, giving to the cliff-face the likeness of a gigantic organ. We soon see that this columnar structure, becoming more coarse and bold in Benmore itself, is responsible for the characteristic sheerness of the mass. The columns break off along the joint-planes, and provide the formidable blocks, clean in the side, sharp at the angles, which are added yearly to the talus.

And soon this manifold talus threatens us. Hitherto the sandstones have furnished us with ledges, on which the grass gives foothold; it has been easy to climb to the base of the cliff-wall, or to descend to the terraces along the shore. But now, across the rivulet that falls in cascades out of Lough Doo, the streams of stones stretch down seaward, bare and continuous, from the crag. Each has to be crossed with forethought; a grassy interlude may or may not lie beyond it; it is certain that another stone-stream will appear to bar the way, hidden by the one with which we are immediately concerned. Some of the individual blocks are large enough to be identified miles away. Thus the projecting masses, heaped on one another below Lough Doo, four or five together, form a group which is descried from Ballycastle.

A stout stick without a ferrule, which will not slip when the weight is thrown on it, serves one well amid this scene of desolation. The camera is strapped firmly on the back, the geological hammer is thrust into the collecting-bag, only to be produced when wanted; for the two hands are here as useful as the feet. A good walker has twice rounded Fair Head in a day, jumping from block to block. For the ordinary person—and he should be one who knows something about taluses—I would say, neither begin to jump, nor hesitate at any point too long. The experience gained on ordinary "screes," where one can thrust a long stick against the slope above one, and ascend the more stable blocks as on a staircase, avails one little on Fair Head. The walk is an almost continuous scramble, and it seems a matter of chance whether one succeeds or fails. Two men together should be almost certain to succeed. One man alone may find it more discreet and business-like to fail.

Though the whole crag rises only 636 feet above the sea, the sense of gloom, of voiceless walls of rock, of absolute and naked savagery, soon becomes impressive and supreme. The cliff above is unnotched throughout a barren mile, a mile that may occupy an expert for an hour, a cautious walker for two or more. Once round the northern angle, the view widens, and Scotland grows clear across the sea. The high masses on Kintyre loom up near at hand; Islay lies out there to westward; and between them, pink with haze, or just caught by a wisp of sunny cloud, we may see the Paps of Jura, and the long ridge stretching up to Lorne.

A startled gull wheels up crying from below us; above us towers the impregnable fortress, steel-grey, gloomy, and impenetrable. The blocks over which we scramble seem rarely less than ten feet long; they are sometimes as large as a cottage, set obliquely or on end. Between them, the interspaces would easily admit

* *See* "Volcanoes of the North," KNOWLEDGE, Vol. XXI. (1898), p. 266.

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a man; and small chance of succour from Murlough or Ballycastle comes that way. The absence of small stones makes the Fair Head talus in certain places almost gruesome; the fissures widen out into caverns, which have no true floors, but from which one might slip, down the face of one stone or another, till the earliest and lowest layer of the mighty pile was reached. Fortunately, the sharpness of the edges and the angles prevents movement of the blocks themselves; a rocking stone is scarcely met with, and foothold on the crystalline dolerite is secure.

At one point, a huge mass of columns has slid down the cliff-face without serious fracture, and remains propped up against its parent, a giant's step to the summit of the wall. Below it is one of the roughest streams of *débris*; then again an easier interval, with tufts of grass and moss, forming bridges that are often serviceable enough. Again and again an ordinary mortal has to let himself down over a joint-face by his arms, to find a foothold on the angle of some lower stone, and then to climb out on the opposite side, like a spirit escaping from a tomb.

All this is no doubt exhilarating, but equally laborious; on this winter's day, despite the superb clear weather, I confess that I was content to fail. I had thought of gaining the grassy paths of the old collieries in Murlough Bay, and returning serenely by the Ballycastle road; but, close against the goal, there runs a deep channel in the talus, with blocks of forbidding bulk upon its southern side. I scrambled up and down, could not see my passage, except into the mysterious and communicating vaults below, and preferred to return over the way already known. The strange character of the talus was demonstrated by the fact that again and again one crosses a piece of broken ground by the same stones or the same gaps that have been selected on the outward way. The choice on the return journey is limited by the fact that there is often one passage, and no other. Again I write for the very ordinary mortal; the talus might seem a Jacob's ladder to a cragsman.

The landmarks by which progress can be reported are the great erratic stone on the very edge of the cliff, left there during the ice-age, before the crag was carved back to its present line; this or that conspicuous block, resting freshly on the apex of a grey stream of its predecessors; or some feature of the columns on the wall, such as the point where they are undercut, and actually overhang the base. The scale of the rocky landscape is so large that one hails the passage of these points in succession, until the last wedged up and projecting pile comes in sight, close against the streamlet from Lough Doo. Even here, there is a climb down to the grass-slope before the grim masses are forsaken. And thence it seems gentle enough to Ballycastle.

Murlough Bay, if one should reach it by this route, or by the legitimate road across the headland, presents beautiful rock-contrasts, even to the untrained eye. The cliff of chalk, high above the wooded combe, rests on red Triassic strata; these again have a foundation of old crystalline schists. Above the whole, grey in the north-west, the dolerite crag of Benmore rises, as a memorial of the volcanic epoch, to which we owe equally the high ridge of Slemish, and the mosaic pavement of the Giant's Causeway. Along this coast, the form of Fair Head perpetually haunts us; some artist should record it in a hundred aspects, as Hokusai painted Fujiyama.

THE RINGED PLAINS OF THE MARE NUBIUM.

By E. WALTER MAUNDER, F.R.A.S.

THE accompanying photograph was taken by MM. Loewy and Puiseux at the Paris Observatory on 1896, September 29. A portion of this same region—the western shores of the Mare Humorum—was given in the December number of KNOWLEDGE for 1899, under the title of "Hippalus and its Surroundings," and was an enlargement from a photograph taken at the same observatory on 1896, April 23. In the earlier paper, attention was chiefly drawn to the deep clefts in the mountainous region west of the Mare Humorum, which follow the outline of the sea itself; to the bold ridges in the sea, which are roughly parallel to both the clefts; to the border of the *Mare*, and to the ramparts—broken down or completely submerged on the seaward side—of the walled plains that are set round the Mare Humorum.

The present plate covers a much wider area. Stretching along its south is a very mountainous and disturbed region, where great ringed plains and rough congeries of unshapen hills seem at some early date to have striven together for supremacy, and where both, indifferently, are now pockmarked by the small deep craters of later convulsions. Hainzel is half out of the picture. Heinsius, almost eaten up by its three parasitic craters, is on the border to the west. The giant triplet of Pitatus, Gauricus and Wurzelbauer are almost on the terminator, and Capuanus, Ramsden, Mercator and Campanus lie in the southern centre.

To the east and north-east are the Mare Humorum and the Oceanus Procellarum. The first is not well seen on this photograph owing to the conditions of the exposure and development, but the huge walled plain, Gassendi, on its northern shore, is very well shown, and the highlands which extend from it to the borders of the ruined plain Letronne.

The whole centre of the photograph is occupied by the Sea of Clouds, and its floor presents a study of walled and ringed plains, in all states of preservation and decay. Bullialdus, the greatest and deepest of those on the floor of the sea, seems also to be of the most recent date, and from its south-west border there comes a curved chain of four craters, Bullialdus A, B, C, and Agatharchides A, the largest craters in the *Mare*.

To the north, Lubiniczky is evidently much more antique, and its ramparts are weathered to a smooth round curve; its floor is flattened to a dead level, and neither Schröter, Mädler nor Schmidt have been able ever to detect any irregularities upon it. In the photograph, the wall has a distinctly horse-shoe appearance with the opening to the south-west, but Neison draws a continuous ring, as distinct on the south-west as on the north-east. Close examination of the photograph shows that the wall is continued right round, four buttresses apparently blocking the entrance to the horse-shoe.

In a much worse state of preservation is Fra Mauro, which lies further to the north-west and almost on the terminator. At some places its wall is very much defaced, in others quite broken down. In its eastern border, there is a deep irregular depression which is continued towards the north through the highlands and the low-lying country beyond, as far as to the east of Gambart A; and cutting the ringed plain of Fra Mauro in two and passing through its central craterlet, is a very delicate and fine rill which Neison traces from the

XUM

NORTH.

THE RINGED PLAINS OF THE MARE NUBIUM.

From a Photograph taken 1896, September 29, 16·0h. Paris Mean Time, with the Great Equatorial Coudé of the Paris Observatory.
Scale :—Diameter of Moon, 23 inches. Moon's Age, 22d. 14·1h.

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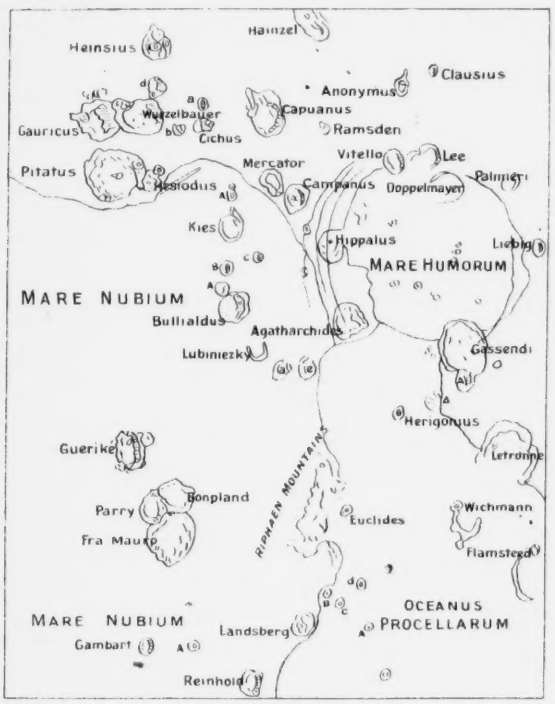
mountainous district to the north, through the plain, and along the floor on the base of the eastern rampart of Parry, and skirting the eastern flank of the crater Parry A.

There are several of these very delicate rills seen on the photograph. They usually appear cleaving the floor of one of the ancient walled plains. One still finer than that crossing Fra Mauro, traverses Letronne from north to south, and seems to end in the highland country lying between Letronne and Gassendi. Another and very remarkable one, not mentioned by Neison, cuts Gassendi itself right across from east to west. It seems to mark the limit which the Mare Humorum would have reached had not the ramparts of Gassendi been already there, and it is a continuation as a *rill* of the mountain *ridge* that forms the eastern border of the *Mare*, and that joins the rampart of Gassendi immediately to the south of the triangular ridge, Gassendi H. This eastern border of the Mare Humorum



Key Map of Plate.

is itself a remarkable object. It is evidently complementary to the three deep parallel clefts on the western banks of the sea, but in its northern part it is decidedly a ridge; in its southern, where it passes through Doppelmayer *g*, its nature is doubtful, for Neison calls it a "rill" there, and Loewy and Puiseux term it a "terrasse."

About half-way between Bullialdus and Guerike, and slightly inclined to the meridian, is seen a chain of three or more ringed plains far advanced in ruin. At least the photograph presents them almost unmistakably as ringed plains, but Neison in his "Moon" figures only the most northern member of the chain as such, not perceiving the western or separating walls of the more southern. At the north-east and south-west corners of the central plain, where it cuts the outer members of the chain, are two craters of comparatively recent origin, and a straight rill unites the two and is tangential to their north-western flanks. We seem here to see the cause of the ruin and semi-obliteration of the ringed plains in the conjunction of rill and crater, both signs of weakness in the lunar crust, and causing subsidence on one side and upheaval on another.

Due east of the triplet of walled plains, Fra Mauro, Parry and Bonpland, and about half-way between them and Wichmann, lies a curved and continuous range of hills, the Riphaen Mountains. The curve of these hills appears on the photograph to be continued towards the west and then round to the south by a series of isolated peaks, and the central floor is smooth and unbroken save for a pair of very small craters, so that the impression is given that here we have the remnants of a huge walled plain, many times larger than Gassendi, whose ramparts are still intact on the east, much broken towards the north and west, and entirely submerged towards the south.

Still another instance the photograph seems to give of a walled plain that has now become not only partially but entirely submerged. To the south-east of the Riphaen Mountains are two craters, Herigonius B and C; and round C, the more southern of these, is seen a broad circular dark marking that looks like the wall of an ancient plain that has been not only levelled, but even depressed below the surrounding surface by the action of the great central volcano.

The most perfect and stable in appearance of all the walled plains seen on the photograph is Gassendi. The north-east corner shows a marking on the floor which forms a curious copy of the shape of Gassendi itself with its great parasite ringed plain, Gassendi A, hanging on its northern border.

Two other curious markings are seen, triangular in shape. One is the deep right-angled triangle that is stamped on the northern spur of the Riphaen Mountains, the other is a deep-triangular impression in the mountainous region to the south of Cichus A.

THE GREAT SOUTHERN COMET (1901 I).

By W. F. DENNING, F.R.A.S.

THE brilliant comet which suddenly appeared in the morning sky on April 24 incited widespread observation and comment from southern observers. The merit attaching to its first discovery apparently rests with Mr. Arthur Hills, of Queenstown. The object, apart from its conspicuous and almost startling aspect, formed a view, very picturesque of its kind, in the twilight over the eastern horizon. It exhibited a short, brilliant and almost vertical tail with a dark rift running lengthwise along its central part, and during May there was a long filmy streamer, or faint secondary tail, directed to the south and inclined at an angle of about 35° to the brighter tail. Major Eddie, who obtained some magnificent views of the comet at Naauwpoort, S. Africa, says that on May 6 "the bright straight tail with its faint extension was about 16° long, reaching nearly to Rigel, while the enormous lateral emission of shimmering light flooded the S.W. sky with a ghostly gleam 40° long, 6° to 10° broad; while the whole space between this mighty extension and the more brilliant tail was filled with a gauze-like sheen." (*B. A. A. Journal*, June, 1901.)

Several of the observers may be said to have discovered the comet for themselves, for they had no intimation of the presence of the brilliant visitor until they saw it shining in the sky. When it was first

noticed it was situated to the S.W. of the sun, and in perihelion; a few days afterwards it passed about 15° south of the sun, and became visible in the evening sky. The faint broad stream of luminous material which formed the secondary tail was curved near its southern extremity, and it remained visible, under various modifications, from May 2 to 27. It may be interesting to summarize the estimated lengths of the two tails, as given by several observers:—

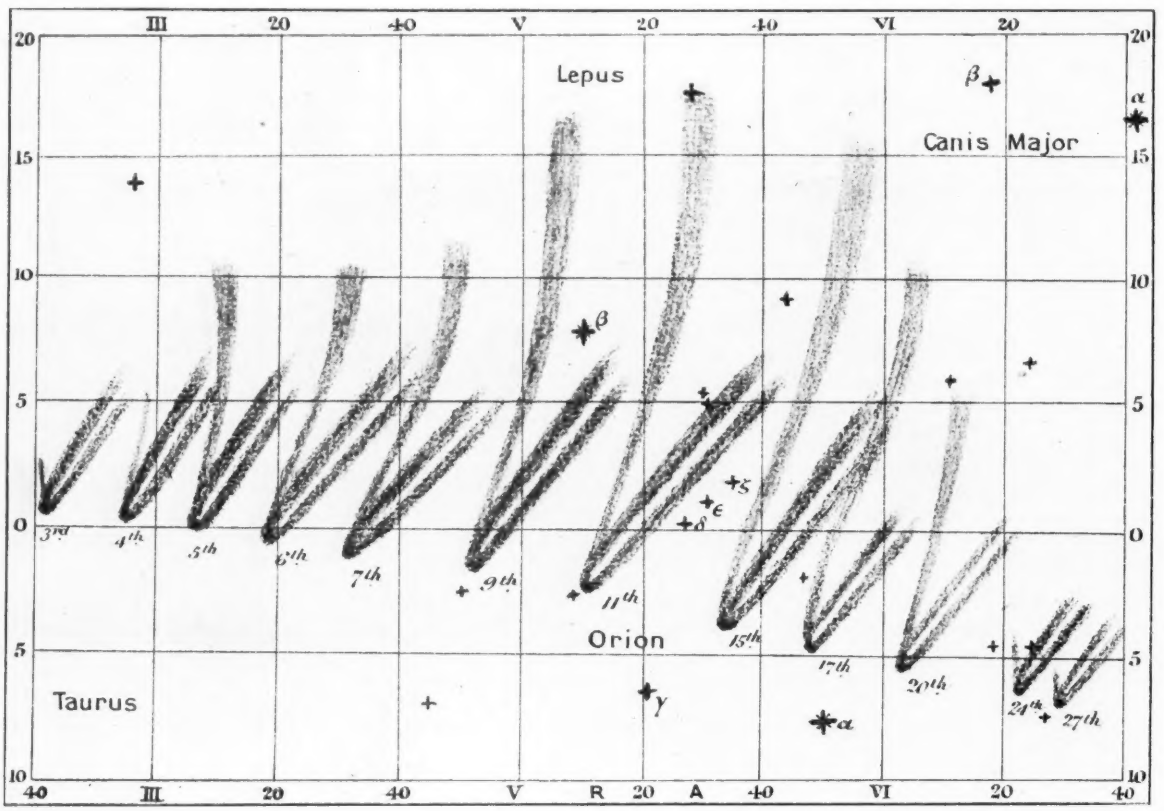
Date.	Bright Tail.	Secondary Tail.	
	°	°	
April 25	10	...	R. T. A. Innes, Cape Town.
May 6	7½	30	J. Lunt, Cape Town.
" 12	7	25	
" 5	10-12	25-30	J. T. Bird, Dullstroom, E. Transvaal.
" 3	> 5	—	C. J. Taylor, Cape Town.
" 9-11	8-10	20	
" 15	—	23	
" 6	5-10	25-30	A. M. Megginson, Sydney.
" 6	8	25	C. J. Merfield, Sydney.
" 2	5	—	L. A. Eddie, Naauwpoort, S. Africa.
" 3	—	10	
" 4	—	12	
" 5	12	20	
" 6	16	40	
" 8	—	40	
" 10	12-14	25-30	
" 11	16	—	
" 14	18-20	30-35	
" 19	15	25	

The comet remained prominently visible to the naked eye until about May 27, after which moonlight practically obliterated it, but Major Eddie watched it in a field-glass until June 10, when it appeared as a faint nebulous streak. (*B. A. A. Journal*, June, 1901.)

A large number of descriptions and drawings of the comet have been received from S. Africa, Australia, and other regions, and a number of these have been published in the scientific journals. A series of sketches were made by Mr. C. J. Taylor, of Cape Town, and these show the general aspect and approximate positions of the object very well. Possibly, however, the angle between the bright main tail and the faint long streamer is not represented sufficiently great, as photographic views of the comet show the inclination to have been about 32° on May 6 and 7.

Mr. Taylor, writing on May 28, from Kenilworth, Cape Town, says:—"On the morning of April 27, I caught a glimpse of the comet, but it was too near the sun to be observed with advantage. On May 3 it was observed directly after sunset, and was a very conspicuous object on the 4th, when the tail was over 4° in length and divided in the middle by a clear dark space, the preceding portion being much wider and more defined than the following. A shorter secondary tail, very indistinct, was to be observed in the telescope sweeping to the east. The comet became a splendid object thereafter and was seen to the greatest advantage between the 6th and 15th, the best views being obtained on the 9th and 11th, when the main tail extended over 8 to 10°, still being clearly divided; while the secondary and fainter tail made a graceful sweep over fully 20°

South.



North.

FIG. 1.—The Great Southern Comet (1901 I.). From sketches by Mr. C. J. Taylor.

and could be traced to μ and α in Lepus. The head was very bright and about equal in diameter to Mars at present. On the 15th the fainter tail was about 23° long and reached nearly to β Canis Majoris. Since then the comet has declined rapidly, and at present, owing to the moon, is practically invisible to the naked eye, though easily picked up in the telescope. From the 5th to the 11th there were apparently two fainter rays or tails to be seen on either side of the main tail. I attach a rough chart showing the positions of the comet from May 3rd to the 27th, the sketches of the 4th, 6th, 9th, 11th, and 15th, in particular giving the general appearance of the object on those days as seen in a $3\frac{3}{4}$ inch equatorial by myself."

Mr. H. Farnill-Scott, of Fort Hill, British Central Africa, writes on May 23:—"While proceeding on Government business up Lake Nyasa on the s.s. 'Adventure,' I observed a comet, and thinking some details of its appearance may be of interest, I venture to submit the following excerpts from my diary. I may mention that some few days previous to my noticing the comet my friend, Lieut.-Commander E. J. Sparkes, R.N.R., remarked to me at Fort Johnston that he had observed a comet on April 27 or 28 just before sunrise, and situate some 10° below the morning star; this, I presume, is the same object as that observed by me.

"May 2, 1901. At 6.30 p.m., immediately after sunset, when off Usiska (on the western shore of Lake Nyasa), in latitude 11° 8′ S. and longitude 34° 12′ E., I observed a bright comet travelling due north at an angle of 30° with the horizon. The tail appeared as a single column of light slightly wider at its furthest distance from the head and brighter at its edges than in the centre, the upper edge being the brighter and slightly convex. The head seemed surrounded, at any rate, in front, by a dark zone. Moon nearly full; the comet disappeared behind a hill at 7 p.m.

"May 3, cloudy. May 4, arrived at Karonga, latitude 9° 90′ S., longitude 33° 9′ E. Noticed the comet at 6.40 p.m., and the moon not being quite up, it appeared brighter and the tail seemed longer. It set about 7.10 p.m., the tail being visible for some little time longer.

"May 5. Saw the comet at 6.55 p.m.; it was situated then directly under the belt in the constellation Orion and looked much brighter; it set about 7.20 p.m.

"May 6, cloudy. May 7. The comet came into view at 7.14 p.m. The tail was now much brighter and showed some signs of cleavage, the upper portion being almost parallel with the sword belt of Orion. Set at 7.27 p.m.

"May 8, 9, and 10. Kept the comet under observation with varying success, due to the presence or absence of cloud and rain; its angle with the horizon had become more vertical.

"May 11. This evening I watched the comet from 7 to 7.36 p.m. The tail now partook of a V-shape, the upper rays being still brighter than the lower ones and still convex, the two sets of rays embracing Orion's sword. The meridian line between the two sets of rays formed an angle of 45° with the horizon.

"May 12, 13, and 14. I was down with malarial fever and could make no observations of the comet, but was informed that there was apparently little or no variation from its appearance on previous evenings.

"May 16. Watched the comet from 7 to 7.50 p.m. It seemed to be waning in brightness and visible to a later hour, being higher in the heavens.

"May 17, cloudy. May 18. This morning there was a partial eclipse of the sun; in view of this I was up betimes (4.30 a.m.) hoping to get a morning view of our celestial visitor, but was disappointed, the atmosphere being laden with vapour. Saw the comet again in the evening at 7.10; its angle with the horizon was 60° and it was much dimmer though still quite distinct. The tail was clearly visible after Orion had set. It was much farther north than when I first saw it on May 2. Set at 8.3 p.m.

"May 19 to 22. Though keenly looked for, I was unable to see the comet; these evenings were cloudless and starlight."

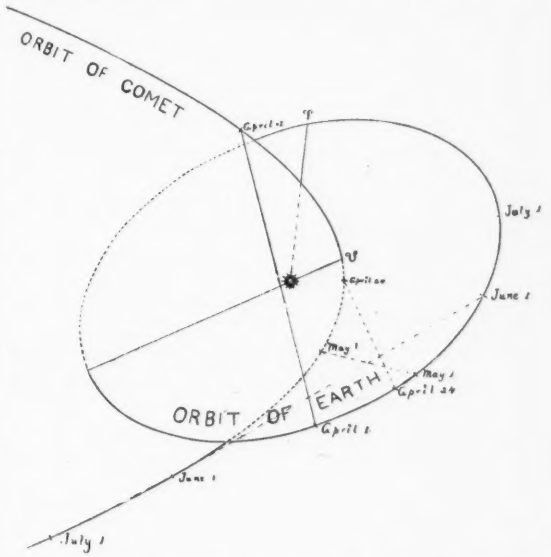


FIG. 2.—Orbit of the Comet and Earth. From *Popular Astronomy*.

The suddenness of the comet's incursion is explained by the path it pursued relatively to the orbit of the earth. It rapidly approached perihelion from the opposite side of the sun to the earth and then the solar rays veiled its approach until, having considerably increased in brilliancy and developed a fine tail, the sun could no longer afford an effectual screen. The comet was then detected even amid the strong light of the circum-solar region, and when it was only 12° distant from the sun. The conditions of its approach were such that regular comet-seekers had very little chance of discovering it, for it was very distant in the earlier months of the year and must have been extremely faint, though projected on a dark sky. And the comet went as it came, under circumstances which prevented its being traced but for a comparatively short interval. When the comet was first seen it was in the eastern extremity of Pisces and travelling rapidly eastwards. Traversing the head of Cetus, it passed between Taurus and Eridanus, was very finely displayed when amongst the well-known stars of Orion and was finally lost as a naked eye object when situated in the head of Monoceros. The comet seems to have been observed at only three northern stations, viz., at the Lick and Mount Lowe Observatories, California, and at the Yerkes Observatory, Chicago.

Very little information has yet been published as to spectroscopic results. Sir D. Gill states in the *Monthly Notices* for June that "the spectrum of the comet

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appears to be continuous; at least with the means at our disposal we have been unable to detect any bright lines."

Elements of the comet have been computed by H. Thiele, of Bamberg (*Ast. Nach.* 3731), from observations on April 24 (Cape Town), May 2 (Windsor), and May 15 (Mount Hamilton), and they are as follows:—

P.P. = 1901, April 24·28824, M.T., Berlin.
$\omega = 203°\ 1'\ 15''{\cdot}8.$
$\Omega = 109°\ 44'\ 1''{\cdot}0.$
$i = 131°\ 1'\ 7''{\cdot}9.$
Log. $q = 9\,388046.$

The perihelion distance was nearly 23 millions of miles, so that this comet did not, like the great southern comets of February, 1880, and January 1887, pass very close to the sun.

The astronomical discoveries that will be made during the present century will undoubtedly be very numerous and some of them brilliant, but it will be difficult for it to furnish a parallel to the first few months of its opening year with its brilliant star and its great comet.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

NOVA PERSEI.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—With reference to the photographs of the Nova Persei region in the July number of KNOWLEDGE, my attention has been kindly called independently by two of your readers, Mr. J. E. Davidson and Mr. J. E. Gore, to what is apparently a bright star visible on the photograph of Feb. 28, but absent from that of Feb. 20. It will be readily found at a short distance south-east of the bright star 36 Persei, visible near the upper (north) part of the photograph. Reference to the original negative shows, however, that this object is not the image of a real star, but is due to a spot on the film; and it is absent from another photograph taken upon the same night.

Now that Perseus is coming round into a favourable and convenient position for evening observation, no doubt many observers will contemplate looking up the Nova, and hence it may be of interest to state that the star is still a fairly bright object. On several occasions lately it has appeared between 6 and 6½ magnitude; and on the nights of the 9th and 10th August, it was plainly visible in an opera-glass. The intense red colour formerly characterising the object seems, however, to have almost entirely disappeared.

A. STANLEY WILLIAMS.

Brighton, 1901, Aug. 12.

DOUBLE RAINBOW.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—Whilst staying at the Göschenen Alp in July last a thunder-storm accompanied by heavy rain passed overhead one afternoon about 5 o'clock. It was not of long duration, and the sun soon shone out brightly from below the western margin of the storm clouds, whilst the rain was still falling copiously at the eastern end of the valley. On this rain a double rainbow of considerable brilliancy was produced and persisted for 5-10 minutes. Not remembering to have seen a similar phenomenon, I venture to mention it to the readers of KNOWLEDGE and to ask for some suggestion as to the probable cause. This was not an ordinary case of a primary and secondary rainbow where the secondary is seen high above the primary and with the sequence of the colours reversed, but there were two rainbows immediately one within the other, both equally bright and broad and the colours in each following the same order as in that of a primary bow—the red of the inner bow and the violet of the outer being apparently in contact as closely as the other bands of colour usually are seen. It occurred to me that there might possibly have been two showers falling at the same time with a dry interval between, and that I had seen a rainbow upon each at such an angle as to exhibit one in apparent contact with the other, but of this I cannot be sure. The rain as it passed over me was a continuous shower, and the length of the clear open portion of the valley down which the storm drifted was not much more than a mile.

R. T. LEWIS.

Ealing, W.,
1901, August 2.

[The double rainbow, to which reference is made in the above letter, was probably an ordinary primary bow with a bright *supernumerary* bow adjacent to it on the interior edge. The appearance cannot be explained in the manner suggested by Mr. Lewis, nor by any simple geometrical theory. Supernumerary bows, of which several are sometimes seen on the inner edge of the primary bow, and occasionally on the outer edge of the secondary bow, are due to the interference of light, and the angular distances between them and the principal bow depend upon the diameters of the raindrops. A full investigation of the phenomena will be found in Preston's "Theory of Light," Art. 301. Some interesting correspondence on the subject appeared in KNOWLEDGE for December, 1900, and February, 1901. —EDS.]

Conducted by HARRY F. WITHERBY, F.Z.S., M.B.O.U.

BLUE-TITS NESTING IN A PUMP.—A pair of Blue-Tits have for several years built about 15 inches down the inside of a pump here. Each time the handle is raised—and the pump is in constant use—the machinery works up through the nest without in the least disturbing the birds. The parent birds enter the pump by an aperture above the handle and leave it by one below.—WILLIAM CHARLES TETLEY, Aspley Guise, Beds.

RED-THROATED PIPIT (*Anthus cervinus*) IN IRELAND (*Zoologist*, July, 1901, pp. 264-267).—Mr. F. Coburn records that he obtained in Co. Mayo on May 26, 1895,

a male specimen of this bird, and that on August 9, 1898, Mr. H. Elliott Howard obtained a further specimen in Co. Donegal. It is a pity that the occurrences were not recorded before, but Mr. Coburn gives his reasons at some length for having omitted to do so. The skins have now been identified by Mr. Aplin, and the occurrence, evidently on migration, of the Red-throated Pipit in Ireland may be taken as authentic. The bird has seldom been observed in Great Britain, and never before in Ireland. That this pipit is so rare a visitor to the British Islands as the records signify is, however, doubtful, since the bird has a wide breeding range in the far north and pushes its migrations in winter to Southern China, India, Persia, and the Nile. Although the normal lines of its migrations do not probably reach westwards of Heligoland, so small a bird undertaking such long journeys must often stray slightly from its course and reach Great Britain, where its great resemblance to the Meadow Pipit has undoubtedly caused it to be overlooked.

THE OCCURRENCE OF THE BLACK KITE (*Milvus migrans*) AT ABERDEEN.—Although a regular summer visitor to many parts of the Continent at no great distance from our coasts, the Black Kite has only once hitherto been observed in the British Islands. This specimen, recorded by the late Mr. John Hancock, as far back as 1867, was taken in Northumberland. Mr. George Sim now records that a male bird of the Black Kite was shot near the City of Aberdeen on April 16, 1901. (*Annals of Scott. Nat. Hist.*, July, 1901, p. 133.) That the bird has not visited this country more often is remarkable because, unlike the Red Kite, which was once so common a resident in England, the Black Kite, as its specific name *migrans* implies, is a migratory species.

Coues Redpoll (*Linota rostrata*) *in Barra, Outer Hebrides* (*Annals of Scott. Nat. Hist*, *July*, 1901, pp. 131-133).—A study of the various races or sub-species of the Mealy Redpoll would be of interest and value to every British ornithologist in assisting to discover the origin of the Mealy Redpolls which visit our islands. Mr. W. Eagle Clarke has lately obtained some specimens of the Mealy Redpoll from Mr. W. L. Macgillivray in Barra These birds Mr. Clarke proclaims to be of the Greenland form originally described by Dr. Coues as *Ægiothus rostratus*. Dr. Steyneger, whose conclusions regarding the Mealy Redpolls are now generally accepted, gave this race sub-specific rank under the title of *Acanthis linaria rostrata*. Mr. Clarke prefers to employ the more usual generic name *Linota*, and to call the bird *Linota rostrata*. In any case whatever name is used, the form is a well-marked one, and is a native of Greenland and North-eastern North America. Its occurrence in Barra is of great interest, since it has never before been detected in Great Britain, although it has occurred as a rare straggler on the west coast of Ireland.

Wigeon Breeding in Ireland (*Zoologist*, July, 1901, p 269).—Although the Wigeon has long been suspected of breeding in Ireland, its nest and eggs have not hitherto been discovered there. Mr. John Cottney now records the finding of several nests and eggs in Co. Down. Mr. Ussher, the well-known Irish ornithologist, has identified both the eggs and the birds' down as those of genuine Wigeon. Surely it is an "injustice" that this record, as well as that of the Red-throated Pipit referred to above, were not first published in the columns of our deserving contemporary the *Irish Naturalist*, which is devoted to the study of the natural history of Ireland.

Supposed Breeding of the Honey Buzzard in Somerset.—In a letter to the *Ibis* (July, 1901, p. 515), Mr. W. Percival Westell records that Mr. Charles E. Nipper found the nests in May, 1897, and May, 1899, in Somersetshire, of birds which were recognised as Honey Buzzards. One nest was half-way down a precipitous cliff, and the other amongst some boulders on the ground. Each nest contained four eggs. Mr. Westell would have done well by giving more particulars in recording these extraordinary finds. The Honey Buzzard exceedingly rarely breeds in Great Britain now, and it is doubtful if it has ever bred so far west as Somersetshire. Two or three eggs form the usual clutch, four being very rarely laid. I can find no recorded instance of the Honey Buzzard breeding elsewhere than in a tree, the nest being usually placed from 25 to 50 feet from the ground. Mr. Westell will doubtless favour us with further details regarding these finds.

Dotterels in Wales (*Ibis*, July, 1901, p. 517).—Mr. O. V. Aplin, on May 10th last, watched four Dotterels (*Eudromias morinellus*) on a mountain in Merionethshire. Although fairly widely spread during migration in other parts of Great Britain, the Dotterel is of infrequent occurrence in Wales.

The Birds of Surrey.—Under the title "Ornithological Notes from Surrey" (*Zoologist*, July, 1901, pp. 247-254), Mr. J. A Bucknill makes additions, more of which are promised, to his admittedly incomplete work, "The Birds of Surrey," published in 1900.

Bird-migration in the Riviera.—Under the title "On the Ornithology of the Var and the adjacent Districts," Mr. J. H. Gurney publishes an article in the *Ibis* for July, 1901, which will be of considerable interest to students of the migratory movements of British birds.

Ivory Gull in Northamptonshire (*Ibis*, July, 1901, p. 517).—Mr. O. V. Aplin writes to the *Ibis* that an immature specimen of the Ivory Gull (*Pagophila eburnea*)—a truly Arctic Gull and an occasional straggler to Great Britain—was shot at Weston-by-Weedon, Northamptonshire, on February 7th, 1901.

Little Bustard in Derbyshire (*Zoologist*, July, 1901, p. 270).—Mr. W. Storrs Fox records that a female specimen of the Little Bustard—an occasional visitor to the British Isles, and usually occurring in the colder months and in the southern and eastern counties—was shot by a farmer near Youlgreave, in Derbyshire, on May 14th, 1901.

Report on the Movements and Occurrence of Birds in Scotland during 1900. By T. G. Laidlaw, M.B.O.U. (*Annals of Scott. Nat. Hist.*, April and July, 1901, pp. 67-79 and 134-145).—Mr. Laidlaw's annual contribution on this subject to our contemporary will be found of much value to students of migration.

All contributions to the column, either in the way of notes or photographs, should be forwarded to HARRY F. WITHERBY, ***at 10, St. Germans Place, Blackheath, Kent.***

Notices of Books.

"ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION FOR THE YEAR ENDING JUNE 30TH, 1898." Pp. lvi., 713. (Washington: Government Printing Office. 1899.) Illustrated.—Though the Smithsonian Report does not reach British periodicals until some years after the date to which it refers, it is always welcome on account of the collection of scientific papers given in the appendix to it. Only one hundred pages of the present report are concerned with the affairs of the Smithsonian Institution; the remaining pages are taken up with reprints and translations of important papers on scientific subjects published in 1898 in various periodicals. These papers are accompanied by numerous plates and text illustrations, and they give a comprehensive view of scientific thought and expression in the year covered by the report. All matters of wide scientific importance form, at one time or another, the subjects of discourses or semi-popular descriptions by leaders of science, hence it is possible to refer to the Smithsonian Reports for authoritative statements on almost every subject which has engaged the attention of the scientific world. The translations will be of exceptional value to students who do not read foreign languages with facility.

"PAPERS ON MECHANICAL AND PHYSICAL SUBJECTS." By Prof. Osborne Reynolds, F.R.S. Vol. II. Illustrated. (Cambridge: University Press. 1901.) 21s. net.—By the publication of the papers in this and the previous volume, the Cambridge University Press is exercising its proper functions. The collected papers of men whose contributions to the advancement of knowledge are of permanent value may not appeal to a large public, yet great service is done to present and future investigators when the papers are brought together in a form convenient for reference. Prof. Osborne Reynolds's papers belong very decidedly to the scientific literature deserving preservation. The earlier volume included forty papers, and the present one brings the number up to sixty-seven, the years in which the papers appeared extending from 1881 to 1899. It is impossible here to describe the many subjects dealt with in these papers, but we can give reasons for our appreciation of them. In the first place, Prof. Osborne has a style of composition which many scientific men would do well to emulate. He does not write for children, or preach down to an uninitiated public, but practically everything he describes is presented in the simplest terms that the subject will permit. Another sign of Prof. Reynolds's genius is that subjects which he took up years ago have suggested

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lines of work to other experimenters. For instance, the resistance to the suction of water in pipes, and the study of fluid motion by means of coloured bands, formed the subjects of detailed papers by him in 1883 and 1893 respectively; and it is worth while to read these papers in connection with later ones by other authors on related subjects. Another instance is the long report on experiments made to determine the action of waves and currents on the beds and foreshores of estuaries by means of working models. As an example of a scientific investigation, carried on with all the refinements of modern methods, we may mention the determination of the mechanical equivalent of heat, described in the Bakerian lecture of the Royal Society in 1897. These are only rough indications of the contents of the volume, but as "good wine needs no bush," so Prof. Reynolds's work does not require advertisement in the scientific world. It will live to please and inspire generations of students of science.

"THE CROCODILIANS, LIZARDS, AND SNAKES OF NORTH AMERICA." By Prof. E. D. Cope. Pp. 1294. Plates 36. (Washington: U.S. National Museum. 1900.)—This posthumous work of Prof. Cope forms practically the whole of the Report of the U.S. National Museum for 1898, and is an important monograph on the scaled reptiles of North America. The geographical scope is the Nearctic geological realm, and the work constitutes the first general account of the North American Sauria or Lacertilia since that of Holbrook in 1845, and the only one on the Ophidia since the book of Baird and Girard, published in 1853. With the exception of a few pages the present memoir is naturally taken up with the lizards and snakes of these groups, which are with sufficient justification arranged in one order —Squamata. Taking the lizards as a centre, it is suggested that three series can be distinguished proceeding from the multiplicity of forms exhibited by them—namely, one towards the serpents by the subterranean lizard, Amphisbæna, found in the warmer parts of South America, one to the partially degraded type of the Geckos, and lastly through the highest series to Chamæleons. This relationship, however, is open to objections, and is not likely to be approved by all herpetologists. The order Loricata, including alligators and crocodiles, appeared in Triassic time, and has continued up to the present day. The genus Alligator is, however, of much more modern origin than Crocodilus, no undoubted extinct species having been discovered. The *Alligator mississippiensis* is the only species found in North America, one of the two other species of the genus occurring in China, while the habitat of the third is unknown. It appears that the alligators of North America cannot long escape extermination, and that the price of hides has gone up on account of the scarcity of the reptiles. The only crocodile described is *Crocodilus americanus*, though, unlike alligators, crocodiles are found in Africa, Southern Asia, and North Australia. The crocodile also differs from the alligator in its preference for salt water, and in being more vicious.

"THE USE OF WORDS IN REASONING." By Alfred Sidgwick. (A. & C. Black.) 7s. 6d. net.—A little logic is a dangerous thing, especially if it is the scholastic form of logic which is obscured with formalities. Opposition to this formal logic is one characteristic of Mr. Sidgwick's book; and there is no doubt that his objections require consideration from the schoolmen. Logic as often studied for examinational purposes is itself illogical; for it involves the acceptance of definitions and doctrines which do not admit of rigid proof. This, however, is a failing of text-books of other subjects. What Mr. Sidgwick urges is that logic resembles the natural sciences in being progressive and full of problems only partly solved; and that the student should recognise this in taking up the subject. In other words, the student of logic should from the commencement be encouraged to view the subject in an inquiring frame of mind, even as he would such subjects as physics and chemistry in schools, where the "heuristic" method was followed. We are, of course, in sympathy with Mr. Sidgwick's aims, but at the same time we must remark that, like other logicians, he seems to labour much that it obvious to the ordinary person.

"TWENTIETH CENTURY INVENTIONS: A FORECAST." By George Sutherland, M.A. (Longmans.) 4s. 6d. net.—Man, it is often said, is distinguished from all other mammalian vertebrates by his power of looking before and after. Nothing is more fascinating than to compare the present conditions of life with those of former times, and it is natural that after such retrospective glances the mind should proceed unconsciously to state a simple proportion—if during the last hundred years the world has seen such and such advances, what may be expected, taking the same rate of progression for granted, during the twentieth century? And what are the signs of the coming of these improvements destined to revolutionise human relations? Such is, expressed in its simplest terms, the problem which Mr. Sutherland sets himself to solve. But, unfortunately for the correctness of their results, there is a disturbing factor in the computation, which these prophets are apt to ignore. In passing from the known to the unknown in a diagnosis of the future it is beyond human power to allow for the unexpected, yet the unforeseen discovery has taken the most important part in nineteenth century advances. The most far-seeing man of science, with an unequalled endowment in the way of scientific imagination, trying in 1801 to probe the mysteries of the future could not have foreseen, for instance, even "through a glass darkly," the development of spectrum analysis in astronomy. So that the prophet is doomed to partial failure. There is, however, much useful work left for him, and this possible task of indicating the probable direction of the earlier improvements of the twentieth century has been attempted with much skill and considerable success by Mr. Sutherland. From the point of view of an ordinary cultured reader, with no knowledge of a technical kind, the author has indulged, perhaps, too much in detail, especially in the first two or three chapters, in which the sources and storage of natural and artificial power are examined. In some other sections, on the other hand, data are provided sufficient for the justification of several delightful glimpses of, to name an example or two, life at sea and the home circle in fifty years' time. His intimate knowledge of the inventions and discoveries of the last century has enabled the author to produce an entertaining book which should soon have a large number of interested readers.

"THE MICROSCOPE AND ITS REVELATIONS." Eighth Edition. (Carpenter.) Edited by the Rev. W. H. Dallinger, D.SC., D.C.L., LL.D., F.R.S., etc. 817 illustrations in the text, 23 plates, 1136 pages. 8vo, cloth, 28s.; half calf, 32s. (J. & A. Churchill.)—The appearance of a new edition of this standard work on the microscope and its many branches is particularly welcome, for it enables a comprehensive survey to be made of the progress that has been effected during the last few years in both optical and mechanical departments, and indicates the pressure that modern research has brought to bear on manufacturers, causing them to do their utmost to satisfy the needs of workers. In a former edition of this work—the seventh—the editor, the Rev. W. H. Dallinger, condemned in no uncertain language, the microscope known as the Continental Model; and laid down broad but sensible lines for the building of the stand that was to meet the demands of the various workers of the future. It was in that edition also that a strong plea was urged on behalf of the condensers having large aplanatic apertures and for increased accuracy in manipulation generally. A reference to the new edition of the work shows how accurate were the author's opinions and recommendations, and they were undoubtedly no inconsiderable factor in the general improvement that has since taken place in the design, and accuracy of action, of the best microscopes of to-day. This is revealed in the pages of the new volume, for many of the microscopes therein figured and described as types have been designed since the last edition was published, and owe their origin in some measure to the strong expressions of opinion then made. The present volume gives a clear exposition of knowledge and theory regarding the microscope; and although much of the text is to be found in the former edition, there are many new and re-written portions which add to the value and lucidity of the book. The reviews of the products of the various opticians are generous and fair, and will be found useful to those who need advice in the choice of apparatus. It is a matter for regret that the publishers have not seen their way to issue the book in two volumes—one devoted to the microscope and its optical fittings, and the other to the various branches of research with which it is associated. Many workers would require only the first part, while the second would appeal to general readers as much as to microscopists. In its present form it is rather a bulky book, especially for those who are resident abroad or travel with their microscopes. A little error concerning cover glasses has been perpetuated in the new volume, page 439. Not only are the thicknesses given for the three grades of cover glasses less than can be regularly obtained, but the thinnest covers are universally known as No. 1, the medium as No. 2, and the thick as No. 3, whereas the reverse order is there given. Also the price of a $\frac{1}{6}$ in. .82 N.A. objective on page 374 given as £3 should be 30s. The book is well printed, the illustrations carefully prepared and well displayed, and the book is one that will be found invaluable as a text book to all microscopists.

"DISEASE IN PLANTS." By H. Marshall Ward, SC.D., F.R.S., etc. (Macmillan.) 7s. 6d.—Prof. Marshall Ward has given us a useful and practical study of the general life of plants, and the causes and effects of the various forms of disease to which they are subject. The book is written essentially with the view of helping the cultivator—whether forester, vine-grower, or grower of roots or cereals—to understand the general facts of plant-life, the relation of plants to their environment, and the nature and symptoms of the various maladies to which they

are subject, thus forming an introduction to more special studies of the diseases and their remedies. Particular emphasis is laid on the necessity of treating the living plant itself as the central figure, and all the circumstances of its environment as subsidiary though indispensable subjects of study. The earlier portion of the work is devoted to plant physiology, which is treated historically, and to plant chemistry. The important subject of roots and root-hairs is treated at some length, with a chapter on the characters of soils, and on the leading factors of hybridisation and selection. The second and larger part of the book is devoted to the subject of diseases, and in its turn opens with an interesting brief review of the history of the subject. As to the causes of disease, stress is laid on the fact that very complex problems are involved, and that no one factor works alone either in health or disease, and that a full study of all attendant conditions alone can in most cases lead to useful conclusions. The various forms of disease are then briefly gone through. In the final chapter the author returns to the general consideration of plant life. The book will furnish a very useful introduction to the study of plant disease, and is so written that it can be read with interest by the large circle of plant growers who do not profess any special scientific knowledge.

"THE MEDITERRANEAN RACE: A Study of the Origin of European Peoples." By G. Sergi, Professor of Anthropology in the University of Rome. Illustrated. pp. 320. (London: Walter Scott, Paternoster Square.) 1901.—Students of ethnology will welcome this work, the latest volume of the Contemporary Science Series as a valuable contribution to our knowledge of the origin of primitive European civilizations. Professor Sergi's well-known researches have already been published in Italy in 1895, and in Germany in 1897. In the English edition now before us the author has carefully revised the results of his earlier works, and has added to them some valuable data bearing on the origin of the Neolithic races of these islands. The work has many excellent features. The facts are well marshalled, the exposition of current views on the subject are simple and direct, and the problems are clearly and cogently stated.

In the opening chapters the theories in vogue relating to the various phases of Indo-Germanism are dealt with. These are stated impartially, but each is finally subjected to a destructive analysis. The author attacks, in particular, the orthodox theories relating to the ancient conception of an Aryan civilization, and concludes by proving that the Neolithic races of Europe originated in Africa, and that the Mediterranean basin was the great centre whence the African migrants reached the centre and north of Europe. The main argument of the book is that from the great African stock, which he calls Eurafrican, originated the three varieties of people who inhabit Europe and Africa at the present day, viz., the African variety, the Mediterranean variety and the Nordic or North European variety. He does not dispute the Aryan invasion of Europe, but contends that the Aryan invaders were savages, and that they destroyed the superior civilization which the Eurafrican peoples had introduced. From this the conclusion is drawn that the Greco-Latin civilization is not Aryan, as is commonly supposed, but that it was a product of the Mediterranean species of the Eurafrican stock.

The additions that have been recently been made to our knowledge of the subject by archeological research in Cyprus, Sardinia, and Sicily do not, in our opinion, receive that attention at the hands of the author which their importance merits. The interesting discoveries that have been made during recent years in the Maltese Islands might, too, have received some mention. These islands have played a most important part in the migrations of the pre-historic Mediterranean races to and from Europe and Africa, and much valuable evidence of this has been forthcoming from the caves and later Pleistocene deposits of both Malta and Gozo. The megalithic ruins, too, of Hagiar Chem and Mnaidra, and the rock tombs that honeycomb the hillsides of the islands, are probably without rival in the Mediterranean, both for their admirable state of preservation and for the unique collection of specimens of prehistoric art and of human remains that have been found within them.

Several chapters are devoted to the migrations of the Eurafrican peoples and to their struggles with the Eurasiatic races of whom the Aryans constituted a variety. From the racial mingling which followed, the languages of the Eurafrican and the Eurasiatic became more or less transformed, and to this the author attributes the changes in the language of Italy, Greece, and elsewhere, and the introduction of the Aryan element which is found in the Neo-Celtic of Wales.

The last chapter deals with the evolution of Mediterranean civilization, as shown by the architecture of the tombs and the culture, language and writing of the peoples of the area. The book contains much that is both novel and suggestive, and it is decidedly to be recommended.

BOOKS RECEIVED.

History of English Literature. By A. Hamilton Thompson, B.A. (Murray.) 7s. 6d.

Bird Watching (Haddon Hall Library). By Edmund Selous. (Dent.) Illustrated.

Text-Book of Astronomy. By George C. Comstock. (Hirschfeld Brothers.) Illustrated. 7s. 6d. net.

Thermal Measurement of Energy. By E. H. Griffiths, M.A., F.R.S. (Cambridge: University Press.) 2s.

Was Alfred King of England? By A. Saxon. (Harrison and Sons.) 2s. 6d.

The Photo-Miniature. June, 1901. (Dawbarn & Ward.) 6d.

Gesso Work. By Matthew Webb. (Dawbarn & Ward.) 6d.

Terrestrial Magnetism and Atmospheric Electricity. July, 1901. (Wesley.) 75 cents.

Conférence Astrophotographique Internationale, July, 1900. (Paris: Gauthier-Villars.)

Reports on the Administration of Rhodesia, 1898-1900. (The British South Africa Co.)

Irish Topographical Botany. By R. Lloyd Praeger, B.A., B.E., M.R.I.A. (Dublin: The Academy House.) 10s. 6d.

Obituary.

ELEANOR A. ORMEROD.

British economic science has suffered a loss, irreparable for many years at least, by the death of Miss E. A. Ormerod, whose studies of insects in their relation to the work of the farmer, the forester, and the gardener, had brought her a world-wide reputation. She was born on May 11th, 1828, at Sedbury, Gloucestershire, a daughter of Dr. Geo. Ormerod, known in his day as historian of Cheshire. Living a quiet country life at Sedbury, at Tildesley, at Isleworth, and finally at St. Albans, she constantly occupied herself with observations on plants and insects, and following in the footsteps of Curtis, Westwood, and Riley, came to occupy an unique position as an authority on economic entomology. Her advice, freely given to practical men all over the country, involved her in a laborious correspondence, and the information thus elicited was incorporated in her "Reports on Observations of Injurious Insects," which, commencing in 1877, were issued yearly until 1900. An intimation in last year's Report that failing health would prevent the issue of any more, has been followed all too soon by her death, which took place on July 19th at her home in St. Albans. In addition to the Reports she published several valuable books, including "A Manual of Injurious Insects," "A Text-book of Agricultural Entomology," and "A Handbook of Insects Injurious to Orchard and Bush Fruits." Her life-work was greatly helped by her elder sister, Georgiana, whose death in 1896 she felt deeply. For several years she acted as Consulting Entomologist to the Royal Agricultural Society, and she was examiner in agricultural entomology to Edinburgh University, of which she was the first-made female LL.D., an honour only conferred a year before her death. Miss Ormerod won the confidence of farmers and gardeners both by the painstaking thoroughness of her work and by the business-like nature of her suggestions. Herself a skilful gardener, she never lost sight of the question whether a certain remedy would be practicable and profitable if employed on a large scale. Hence as an exponent of applied science she succeeded better than others whose scientific training and methods may have been more modern than her own. Her caution is well shown by her reluctance to follow American practice in recommending such powerful poisons as copper arsenite or carbon bisulphide as insect-killers. She has well served her day and generation. May her work be carried on by those whom she has so generously cheered and encouraged by advice and example.—G. H. C.

XUM

SIR CUTHBERT E. PEEK, BART., M.A., F.S.A., ETC.

It is with deep regret that we have to record the death of so liberal a patron of science as Sir Cuthbert Peek, who died at Brighton on July 6th. He was the only child of Sir Henry, the first Baronet; was born in 1855, and married in 1884 the Hon. Augusta Louisa Brodrick, daughter of the eighth Viscount Midleton, and only succeeded his father in 1898. He was educated at Eton and Pembroke College, Cambridge, was J.P. for Devon, Middlesex, and London. From early years he was interested in many branches of science and distinguished himself as an active worker in astronomy and meteorology, was a fellow of the Royal Astronomical, Geographical, and Meteorological Societies, of the Society of Antiquaries and of the Anthropological Institute, and served on various councils of the learned societies. He went to Australia in 1882 to observe the transit of Venus, and on his return he drew up the plans for the Rousdon Observatory near Lyme Regis, South Devon, which was built in 1884. Part of his equipment was a 6.4 Merz equatorial telescope, which has been in use since 1885, in his well-known study of long period variable stars. From the observatory, Greenwich mean time was furnished to the district. In addition to astronomical work, he also devoted himself to meteorology, and the annual reports from the observatory were rich in scientific information. In addition to the usual meteorological observations, he made somewhat of a speciality of instruments connected with rainfall and wind velocities, having a registering pluviometer and evaporation tanks, whilst a latticed tower for carrying the anemometers is a conspicuous object of the neighbourhood. Some years ago he conducted a series of experiments for the purpose of determining the factor for getting the true wind velocity from the Robinson cup anemometer, and eventually adopted the Dines pressure-tube instrument as the standard. It was with this latter instrument that he recorded the highest wind velocity ever registered in England during a gale in 1897. Sir Cuthbert was not so keen an ornithologist as his father, but nevertheless he had kept in a good state of preservation the collection of British birds that Sir Henry had made; whilst a never-failing source of interest to the visitor at Rousdon was the ethnographical museum which he had formed. Science indeed is bereaved by the loss of one who had its interests so near at heart.

ASTRONOMICAL.—Additional interest has been given to the well-known "Runaway Star," 1830 Groombridge, by the recent spectroscopic determination of its velocity in the line of sight which has been undertaken by Prof. Campbell at the Lick Observatory. It results from the observations that the star is approaching the sun with a velocity of 59 miles per second, which is much less than the probable velocity of about 150 miles per second with which the star moves across the line of sight. The observations are of special importance as demonstrating the possibility of measuring the velocities of stars as faint as the 8th or 9th magnitude, provided that their spectra contain well-defined lines.

Recent investigations of the spectroscopic binary Mizar (Zeta Ursae Majoris) which have been made at Potsdam indicate that the period is probably 20.6 days, and not 104 days as previously deduced at Harvard. Prof. Vogel further finds that the eccentricity of the orbit is 0.502, and the maximum relative velocities in the line of sight 128 and 156 kilometres per second. The system is approaching with a velocity of 16 kilometres per second.

A list of 59 "objects having peculiar spectra," given by Prof. Pickering in Harvard Circular No. 60, is of special interest, as 28 of the objects are included in the Large Magellanic Cloud. Of these, 10 are gaseous nebulæ, 15 are stars of the Wolf-Rayet type, and 3 are stars of the first type with some of the hydrogen lines bright; it will thus be seen that the cloud not only resembles the Milky Way in general appearance, but is also rich in types which specially frequent the Milky Way. Among other objects described, five are of great importance as having spectra resembling those of the Wolf-Rayet stars, but with the lines dark upon a continuous background.

Owing to the unavoidable delay in Mr. E. W. Maunder's return to England, the Constellation Study which should have appeared in this number of KNOWLEDGE has to be omitted.—A. F.

BOTANICAL.—The *Revue Horticole* for July 16 contains a paragraph respecting the experiments carried on under the auspices of the Imperial Society of Horticulture of St. Petersburg with the view to determine the length of time during which the pollen of various plants will retain its vitality. It is shown that the rose can be fertilised with pollen 22 days old, and species of *Clivia* when it is 3 months old; further, a case is cited where the pollen of some hybrid Clivias had not lost all its vitality after being collected a year. In a later number of the *Revue*, Monsieur Mangin draws attention to his researches into the subject published in the *Bulletin de la Société botanique de France*, Vol. XXXIII., and gives a short list of plants with the length of time that the pollen retains its germinative power in each case. While the pollen of the common wood-sorrel (*Oxalis acetosella*) may be preserved for one day only, that of the *Narcissus* proved capable of growth for 80 days. Monsieur Mangin observes that the vitality of the pollen is relatively short in plants which flower for a long time.

In many tropical countries attention is now being paid to the commercial prospects of the leaves of the coffee-tree as a substitute for those of the true tea-plant in the preparation of tea. The natives of Sumatra, where the coffee-tree abounds, use a beverage made from its leaves in preference to that obtained from the berries, which, in consequence, are allowed to fall to the ground and decay. When grown for its berries, the coffee-tree will succeed only in certain soils and situations, whereas an abundance of foliage suitable for making coffee-leaf tea may be produced on almost any fertile soil. A chemical analysis shows that the leaf contains all the characteristic properties of the berry, but is richer in theine. The editor of the *Queensland Agricultural Journal*, in which some interesting notes on the subject have been published, declares the coffee-leaf tea to be a pleasant and refreshing beverage.—S. A. S.

ZOOLOGICAL.—For some time Dr. G. L. Johnson has been engaged in studying the internal structure of the eyes of mammals under the ophthalmoscope, and the results of his investigation, illustrated by thirty coloured plates, have been published in the *Phil. Trans.* Great variation in the arrangement of the blood-vessels, as well as in the colour of the retina, are noticeable; blue and violet seem to be unknown, while red, yellow, and green form the predominating shades. In the main, the various types of minute ocular structure correspond very closely with the different groups into which mammals are now divided; this correspondence affording important testimony in favour of the general correctness of our scheme of classification. Among the exceptions are the South American squirrel-monkeys, whose eyes approximate in structure to those of the lemurs. In regard to the range of vision possessed by different animals it is mentioned that man and monkeys alone possess parallel and convergent vision of the two eyes. On the other hand, divergent and consequently very widely extended vision is a prerogative of the lower mammals; squirrels, for instance, and probably also hares and rabbits, being able to see an object approaching them directly from behind without the necessity of turning their heads.

A most remarkable discovery has recently been made with regard to the earliest and most primitive whale—the extinct *Zeuglodon*. In association with the remains of this creature have been discovered on more than one occasion solid bony plates, which have been regarded as forming the dermal armour of a turtle. It is now, however, demonstrated that the plates in question belong to *Zeuglodon* itself, which appears to have had dermal armour on the back-fin and certain portions of the back somewhat resembling that of the South American glyptodont armadillos. Traces of a similar armour occur in an extinct Croatian dolphin, and tubercles found on the back-fin of the common porpoise and on the back of the Japanese *Neophocæna* may doubtless be regarded as the last remnants of this structure. As a partial armour would be useless, it may be assumed that the ancestral cetaceans were fully protected by bony plates. But such a rigid panoply would obviously be unsuitable to a pelagic type, such as *Zeuglodon* seems to have been, and it is accordingly presumed that the armour was restricted to part of the back of that animal. The presumption that the ancestral cetaceans were fully armoured must not, however, be taken to indicate that they were descended from mail-clad land animals. On the contrary, they themselves developed the armour, which may have been for the purpose of protecting them from the breakers and the attacks of sharks when they led an amphibious life on the coasts. These interesting investigations are by Dr. O. Abel, and appear in a recent issue of the *Beiträge zur Paläontologie und Geologie Österreich-Ungarns.*

It was recently stated in an official report that salmon do not feed while in fresh water, being afflicted during their sojourn in rivers with a disease of the lining membrane of the alimentary tract. Later observations discredit the correctness of this view, evidence having been adduced that river salmon catch and digest minnows and other fish. The presumed disease of the lining of the stomach is stated to be owing to the fact that the fish examined were not sufficiently fresh. Still, the fact is not disputed that during the time spent in fresh water salmon maintain themselves to a very considerable extent on the store of fat accumulated in their tissues during their marine life.

In *The Graphic* of August 3rd appears an excellent figure of the head and neck of a presumed new type of giraffe obtained by Sir Harry Johnston in north-east Uganda. In addition to an apparently distinct type of coloration the male of this giraffe possesses a pair of low prominences behind the large horns, so that it is called by its discoverer "five-horned." The same issue of the Journal contains a coloured illustration of the new mammal—the Okapi (*Okapia johnstoni*).

Much interest attaches to an article on mother-of-pearl oysters, by Dr. H. L. Jameson, which appears in the August issue of the *Proceedings* of the Zoological Society. The enquiry has been based on the large series of these shells in the collection of the British Museum, and its inception was suggested by Professor Ray Lankester. Perhaps the most remarkable circumstance connected with the investigation is the discovery that the large Austro-Malayan oyster, the valuable "silver-lip" and "gold-lip" of commerce, is a distinct and hitherto unnamed species. For this form the name *Margaritifera maxima* is appropriately suggested.

Another important item in the same journal is a memoir by Dr. A. Smith Woodward on extinct reptiles from Patagonia. The forms described include a tortoise belonging to the genus *Miolania*, hitherto known only from the Plistocene of Australia; a large snake closely allied to an existing South American type, and a carnivorous dinosaur related to the European *Megalosaurus* and the North American *Ceratosaurus*. The two questions of most general interest discussed in this communication relate to the apparent mixture of types elsewhere characteristic of widely separated geological horizons in Patagonia, and to the conclusions to be drawn from the occurrence of closely allied forms in the Australian and Patagonian Tertiaries. As regards the former point it seems either that dinosaurs survived in South America into the mammalian period, or that some confusion has been made between the reptiliferous and mammaliferous beds. As regards the latter, it is suggested that the tortoise may have reached the one hemisphere from the other by way of the Antarctic continent. On the other hand, "it is just possible that, if the direct ancestors of *Miolania* were known, this remarkable chelonian would prove to have originated not on any old Antarctic continent, but in some other region of the globe from which scattered survivors wandered into the lands now named South America and Australia respectively."

CURRENT CARCINOLOGY.

By the Rev. T. R. R. STEBBING, M.A., F.R.S., F.L.S., F.Z.S.

IN the olden time the history of nature was written at less length and with less continuity than at present. Like the "resting-eggs" of Entomostraca subjects were allowed to have a period of quiescence, of peaceful oblivion, before hatching out into new activity. We moderns have changed all that. Be the subject what it may, the discussion of it flows on without ceasing. No one steadily watching that flow would expect it to fail and be cut off. Nevertheless, like the stripling who "in a showerful spring stared at the spate," a novice suddenly confronted with all that has recently been published on the class of crustacea might well give a gasp of surprise. For this, as for other classes of the animal kingdom, there are various records which keep

the student informed as to the titles and the contents of the specialist literature. It is not, perhaps generally understood how much skill and learning and industry are brought to bear upon the compiling of these records. In regard to the fame, the money, and the thanks to be won by such work, there is little of the first, less of the second, and, one might almost say, nothing at all when you come to the third. For the essential service rendered it is no one's business to reward the compilers. On the contrary, the infuriated student is inclined to turn again and rend them, because they do not supply him with money to buy or time to read or the gift of tongues to understand the interminable series of books and pamphlets of which they make him guiltily conscious. It is not the intention of this chapter, then, to compete with these unhappy recorders. Its purpose is rather to show the general reader how large a share in scientific literature is being claimed and how many avenues of research are opened by a subject so modestly attractive, so engagingly unpretentious as carcinology.

This branch of science can no longer be regarded as unfashionable or neglected. Be it by king or prince or republic, by university, museum, or private enterprise, active and generous help is given for its promotion, enlightened interest displayed, knowledge of it largely and rapidly extended. In point of fact, though the picking up of a little crab from the bottom of the ocean may be scoffed at as an insignificant feat, deep-sea exploration, by whomsoever carried out, is royally expensive. The effort lies idle until the results are published. The animals brought to light must be described and figured, and the costliness of adequate illustrations is far higher than the inexperienced would suppose. It should, however, be remembered that the accurate and full delineation of natural objects is a marvellous boon, not only to those living at the time of the discovery, but to a long series of subsequent students. It is a poor jest to ask a riddle to which there is no answer, but that is just like the dull mischief of introducing a new species ill described or half described, carelessly figured or not figured at all. Not seldom the consequence is that for ages afterwards naturalists are worried with the fleeting hope of recognising the unrecognizable. Fortunately the fine books which have lately appeared on various branches of carcinology are armed against any such reproach. It is evident that no pains or expense have been spared to make them satisfy the demands of modern science. The preparation has, in some instances, necessarily been spread over many years. In some cases the materials with which the reports are concerned were obtained by expeditions of comparatively distant date. Thus the decapod crustaceans described by Milne-Edwards and Bouvier for the French Government were collected by the exploring vessels, the "Travailleur" and the "Talisman," in the four successive years from 1880 to 1883.* In another work they deal with the same group from the scientific campaigns of the Prince of Monaco on board the "Hirondelle" and the "Princesse Alice."† In still earlier cruises of the "Hirondelle" the same enthusiastic navigator procured the Amphipoda which are so admirably treated in M. Chevreux's learned and beautifully illustrated volume.‡ An important group of the Amphipoda, which are discussed in a fine memoir by Dr. Vosseler, are from among the extensive fruits of the well-known Plankton Expedition of 1889.§ A great work by Lilljeborg‖ has a different kind of origin. It refers to small animals, almost all of which live in fresh water. For procuring them it is, as a rule, not necessary to commission a man-of-war nor to employ yachts fitted with costly apparatus and the latest devices of mechanical ingenuity. But procuring material and bestowing upon it all the tenderest care of pen and pencil will remain ineffectual unless the cost of publication can be defrayed. In this respect the veteran professor found his path smoothed by the King of Sweden and Norway and the Royal Society of Upsala. Others will join him in his grateful acknowledgments. It should not be forgotten that in the subject of this grand monograph Wilhelm Lilljeborg made his mark so long ago as 1853, and he now tells us that already in that distant time his ambition had conceived the project at length accomplished. His success in bringing out such a work at the age of eighty-four should rank among remarkable performances.

To the volume on the crustacea of the "Travailleur" and the "Talisman" a keenly personal interest also attaches. For three-quarters of a century important treatises on carcinology have issued at brief intervals from the pen of a Milne-Edwards. The famous father Henri lived to a very advanced age. The famous son Alphonse has not equalled him in length of days, although in rendering many and great services to zoology he has faithfully followed in his father's footsteps. On the special subject of crustacea he has for some years past been working with an invaluable ally, Professor E. L. Bouvier. Sad as it is to reflect that this collaboration has now been sundered by the unexpected death of Alphonse Milne-Edwards, at least it closes graciously with a work nobly becoming to the high reputation of both authors.

Another striking volume published last year from Professor Giard's zoological station at Wimereux will presently have to be mentioned, but neither France nor Sweden nor any other country can claim a monopoly of the subject. In Calcutta, Major Alcock is drawing to a conclusion his elaborate account of the crustacea obtained by the survey ship "Investigator."¶ The Cape Government has begun to publish its "Marine Investigations" on the same class.* Mr. Whitelegge, of

* "Expéditions Scientifiques du 'Travailleur' et du 'Talisman.'" Ouvrage publié sous les auspices du Ministère de l'Instruction Publique. Crustacés décapodes. Première partie. Brachyures et Anomoures. Par A. Milne-Edwards, Directeur du Muséum d'Histoire Naturelle, et E. L. Bouvier, Professeur au Muséum d'Histoire Naturelle. 4to, 396 pages, 32 plates, 7 coloured. (Paris, 1900.)

† "Résultats des Campagnes Scientifiques accomplies sur son Yacht." Par Albert Ier., Prince souverain de Monaco. Fascicule XIII. Crustacés décapodes provenant des campagnes de "l'Hirondelle" (Supplément), et de la "Princesse Alice" (1891–97). Par A. Milne-Edwards et E. L. Bouvier. 4to, 87 pages, 4 plates, 2 coloured. (Monaco, 1899.)

‡ "Résultats, etc." Fascicule XVI. Amphipodes provenant des campagnes de "l'Hirondelle" (1885–88). Par Ed. Chevreux. 4to, 195 pages, 18 plates, 1 coloured. (Monaco, 1900.)

§ "Die Amphipoden der Plankton-Expedition." Von Prof. Dr. J. Vosseler. I. Theil. Hyperiidea 1. 4to, 129 pages, 11 plates, 2 maps, 5 figures in the text. (Kiel and Leipzig, 1901.)

‖ "Cladocera Sueciæ, oder Beiträge zur Kenntniss der in Schweden lebenden Krebsthiere von der Ordnung der Branchiopoden und der Unterordnung der Cladoceren." Von Wilhelm Lilljeborg, Professor emeritus. 4to, 701 pages, 87 plates. (Upsala, 1900.)

¶ "Illustrations of the Zoology of the Royal Indian Marine survey ship 'Investigator.'" Crustacea. Part VIII., plates 46-48, 4to. (Calcutta, 1900.)—An account of the deep-sea Brachyura collected by the Royal Indian Marine survey ship "Investigator." By A. Alcock, M.B., C.M.Z.S., F.G.S., Superintendent of the Indian, Professor of Zoology, etc. 4to. 85 pages, 4 plates. (Calcutta, 1899.)

* "Marine Investigations in South Africa." South African Crustacea. Part I., 8vo, 66 pages, 4 plates, 1 coloured. (Cape Town, 1900.)

the Australian Museum, has issued two parts of his "Crustacea" from the trawling expedition of H.M.C. "Thetis" off the coast of New South Wales.† Mr. L. A. Borradaile describes crustacea from Funafuti and Fiji.‡ Mr. W. F. Lanchester deals with a collection from Malacca and Singapore.§ Researches by Vallentin in the Falkland Isles, by Perkins at Hawaii, by Dr. Willey in the South Pacific, have yielded very interesting

Leptodora kindtii (Focke), commonly called *L. hyalina*. From Lilljeborg's *Cladocera Sueciæ*.

results.‖ Dr. Calman describes Brachyura from Torres Straits, collected by Professor Haddon in 1888.¶ Professor Sars, besides concluding the third volume of his "Crustacea of Norway," has published an important essay on the Cladocera of South America.* From the United States come numerous contributions of much value and utility. Among these Miss Rathbun exhibits her commanding knowledge of crustacean lore in "Results of the Branner-Agassiz Expedition to Brazil," and in a paper on the decapod crustaceans of West Africa.** On the Asterocheridæ, a noteworthy group of the Copepoda, Dr. Giesbrecht publishes a scholarly monograph, charmingly illustrated after the fashion for which the biological station at Naples is justly celebrated.†

Besides the systematic works, ranging from thick quartos to thin pamphlets, there are other memoirs dealing with the subject from all sorts of expected and unexpected points of view. For instance, a short paper by Mr. E. A. Mearns records the exceptional dimensions of an American lobster,‡ a long one by Mr. F. C. Waite treats fully the structure and development of its antennal glands.§ Mr. G. H. Parker discusses "The photomechanical changes in the retinal pigment of Gammarus."‖ Mr. S. J. Holmes also has an elaborate paper on "Phototaxis in the Amphipoda."¶ The same author publishes interesting observations "On the Habits and Natural History of *Amphithoe longimana* Smith."* One of his sections is on Thigmotaxis. Let not the reader be daunted. Thigmotaxis is nothing but a tendency to keep in contact with solid objects. We have it ourselves, however much swimmers, aeronauts, and spiritualists may endeavour to set it at defiance. Another section, "On the Effect of Cutting the Animal in Two," may for a moment shock the sensitive. But, as it appears that the swimming feet of the victim's hinder half "kept up their rhythmical beating for fully a half hour," and that its front half was still able to appropriate and devour food, we may hopefully infer that these creatures are not very painfully afflicted even by disastrous accidents. Like ourselves, they no doubt suffer from fear, to impel them to acts of self-preservation, but under the infliction of mortal injuries they have the happiness not to know how badly they are hurt.

Milne-Edwards and Bouvier lay great stress on their classification of the higher Malacostraca. From their point of view the Anomura are not to be regarded as a group intermediate between the Brachyura and Macrura. They hold, in accord with Boas, that lobster-like forms of the latter have given rise to two independent lines of evolution. The result may be briefly indicated by saying that in one line the Dromiacea, or primitive Brachyura, lead up to the genuine Brachyura, or crabs, properly so called; the other line runs out in the Anomura, with three principal branches, the Paguridea, including but not limited to the hermit-crabs, the lobster-like Galatheidea, embracing also the small, flattened, crab-like Porcellanidæ, and lastly the Hippidea. Since there are many in this line to which the term Anomura is by its meaning unsuitable, it would seem to be better to drop it altogether, adopting in place of it the expression Macrura anomala.

For one interesting genus of Galatheidæ the French authors persist in retaining the name *Diptychus*, although it was changed to *Uroptychus* by Dr. Henderson in his "Challenger" report, on the indisputable ground that *Diptychus* had been earlier used by Steindachner for a genus of fishes. They rely on the strange argument that perhaps Steindachner's generic

† "Memoirs of Australian Museum." Vol. 4, Pt. 2, pp. 175-199, plates 33-35, 1900, and Vol. 4, Pt. 3, pp. 203-246, figures in text, 1901.

‡ "Proc. Zool. Soc., London," pp. 568-596, plates 40-42, 1900.

§ "Proc. Zool. Soc., London," pp. 719-770, plates 44-47.

‖ "Proc. Zool. Soc., London," pp. 517-568, plates 36-39, 1900; Fauna Hawaiiensis, Vol. 2, pp. 527-530, plate 21, 4to. (Cambridge, 1900); A. Willey's "Zoological Results," Part 5, pp. 605-690, plates 64-74, 4to. (Cambridge, 1900.)

¶ "Trans. Linn. Soc., London," Vol. 8, Part I., pp. 1-50, plates 1-3, 4to. (London, 1900.)

* "An Account of the Crustacea of Norway," Vol. 3. Cumacea, parts 1-10, 115 pages, 72 plates, large 8vo. (Bergen, 1899-1900.) "Contributions to the knowledge of the fresh-water Entomostraca of South America, as shown by artificial hatching from dried material." By G. O. Sars. Part I.—Cladocera, with 12 autographic plates, 102 pages. (Kristiania, 1901.)

** "Proceedings of the Washington Academy of Sciences," Vol. 2, pp. 133-156, plate 8, 8vo. (Washington, 1900.) "Proceedings of the United States National Museum," Vol. 22, pp. 271-316. (Washington, 1900.)

† "Fauna und Flora des Golfes von Neapel und der angrenzenden Meeres-Abschnitte." 25. Monographie. Asterocheriden, von Dr. Wilhelm Giesbrecht. 4to, 217 pages, 11 double plates, 2 coloured. (Naples-Berlin, 1899.)

‡ "Proc. Biol. Soc., Washington," Vol. 13, pp. 168–9, 1900.

§ "Bulletin, Mus. Comp. Zoöl., Harvard," Vol. 35, pp. 151–210, 6 plates. (Cambridge, Mass., U.S.A., 1899.)

‖ *Loc. cit.*, pp. 143–8, 1 plate.

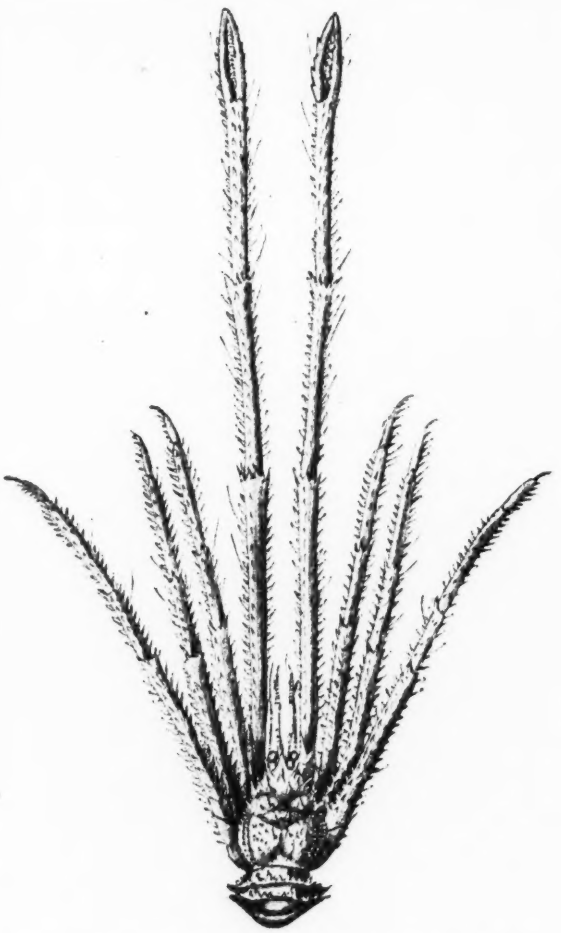
¶ "American Journal of Physiology," Vol 5, pp. 211–234.

* "Biological Bulletin," Vol. 2, pp. 165–193. (Boston, U.S.A., 1901.)

name ought to be made a synonym of something else. Under the name of "*Munida Bamffica*, Pennant," they identify the "*Astacus Bamffius*, Pennant," 1777, with the "*Pagurus rugosus*, Fabricius," 1781, but in this they overlook the fact that Fabricius first described his species not in 1781 but in 1775, so that the proper title now is *Munida rugosa* (Fabricius). Absolute accuracy in names is a thing very difficult to attain. Miss Rathbun, who may be accounted our most learned authority on the subject, in her "Decapod Crustaceans of West Africa" assigns *Palinustus phoberus*, Rochebrune, 1883, to the genus *Palinostus*, Bate. This might seem a very natural thing to do, on the supposition that Rochebrune had accidentally mis-spelled the name. But, as a matter of fact, Bate's genus dates from 1888. It is itself a synonym of *Jasus*, Parker, 1883, but not of *Palinustus*, which was defined by A. Milne-Edwards in 1880. To what genus Rochebrune's species really belongs is none too certain. In the Entomostraca Professor Lilljeborg upholds the genus *Lynceus* and the family Lynceidæ as valid among the Cladocera. Now the truth is that O. F. Müller's genus *Lynceus* was restricted by Leach in 1816, who then distinguished *L. sphaericus* from *L. brachyurus* by placing the former in a new genus designated *Chydorus*. The consequence is that we have in the Cladocera a family Chydoridæ, while the phyllopod family Limnetidæ must assume the name Lynceidæ, since its single genus *Limnetis*, Lovén, includes Müller's *L. brachyurus*, and must therefore revert to the old generic name of *Lynceus*.

In the late William Stimpson it cannot be doubted that the United States possessed a carcinologist of great merit. But his papers are not always easy to meet with, and his descriptions of new species are often very brief and unaccompanied by figures. Thus his work has from time to time to undergo a process of rediscovery. Miss Rathbun in her Brazilian paper describes and figures a new species *Glypturus branneri*, the genus of which is nearly allied to *Callianassa*. This *Glypturus* was instituted by Stimpson, and has evidently long been overlooked till Miss Rathbun dredged it up from the deep sea of forgotten literature. Again, a very notable crustacean, *Hapalocarcinus marsupialis*, was briefly described by Stimpson in 1859. This, it is true, has not escaped the attention of subsequent observers, though they have been more concerned with its habits than its structure. Dr. Calman's paper in the Linnean Transactions is the first to bestow upon it accurate description and adequate illustration. It is not very awe-inspiring by its dimensions, the carapace being only about a tenth of an inch in length and in breadth. But though so small it is in more than one respect a great curiosity. It forms gall-like excrescences in corals, managing to keep open sufficient apertures for the ingress and egress of water, but otherwise allowing itself to be imprisoned by the growth of the coral around it. Since none but females have been found thus walled in, it is conjectured that both sexes are free till after marriage, and that then the females alone become completely domesticated, like the women in Lord Lytton's story of "The Coming Race," who under similar circumstances contentedly shed their wings. Another genus, *Cryptochirus*, Heller, furnishes a somewhat similar species of crabs parasitic on corals, and the two genera form Calman's family Hapalocarcinidæ. This, he decides, must be placed among the true Brachyura, although there are some perplexing resemblances to some of the anomalous Macrura.

The Cumacea (or Sympoda†), with which the admirable third volume of Sars's Crustacea of Norway is wholly concerned, have not as yet yielded any parasitic or commensal species, unless *Nannastacus unguiculatus*, Bate, found in the nest of the mollusc



Ptychogaster formosus (A. Milne-Edwards). A deep sea Galatheid. After E. L. Bouvier.

Lima hians, may be considered an exception. The Isopoda, on the other hand, have shown extreme partiality for the labour-saving expedient of living on their neighbours. M. Jules Bonnier devotes a large and valuable volume to that section of them which are commonly known as bopyrids.‡ These, in their attachment to other crustaceans, develop many eccentric forms. They pass through strange metamorphoses. One division exhibits the character, ever remarkable though not unique, by which the same individual is first a male and then a female. In another division, M. Bonnier inclines to believe that, while the larvæ are potentially of either sex, the one which first obtains a good

† For this change of name see Willey's "Zoological Results," Part 5, p. 609.

‡ "Contributions à l'étude des Epicarides les Bopyridæ." Par Jules Bonnier. Travaux de la Station Zoologique de Wimereux. Vol. 8, 4to, 396 pages, 41 plates, portrait. (Paris, 1900.)

nourishing situation develops into a female, that one of the others then becomes what he calls "a definitive male," the rest having either to bide their time for similar chances, or perhaps having to be content with the lot of Portia's unsuccessful suitors. One genus displays a kind of inverted Mormonism, a solitary female being privileged to have numerous mates strongly attached to her. Messieurs Caullery and Mesnil, writing on *Hemioniscus balani* which is parasitic on cirripedes, note that this is the only crustacean genus yet known in which there are two oviducts on each side.§ The "Notes on some crustacean parasites of fishes," by Mr. Thomas Scott, F.L.S., ought not to be neglected.‖

Of Dr. Birula's papers on Russian Malacostraca it must suffice to say that though the crustaceans themselves are not confined to the dominions of the Czar, the discussion of them is, unfortunately for the monoglot Englishman, exclusively in Russian.¶

The spirited essays in which the eminent Danish zoologist, Dr. H. J. Hansen, has been appealing to his countrymen to shake off political apathy, to cultivate a stedfast friendship with Great Britain, and to set their scientific household in order, would not come within the scope of this chapter, but for the remarkable appendix on "Rhizorhina, Herpyllobius, and Sören Jensen," which the student of Entomostraca ought not to overlook.*

Here the account of current carcinology might well have paused, had not the intention of stopping been frustrated by the coincident arrival of Major Alcock's "Descriptive Catalogue of the Indian deep sea Macrura and Anomala,"† and of a pleasant work by the same author, called "Zoological Gleanings from the Royal Indian Marine survey ship 'Investigator.'"‡ In contrast to the diminutive forms that nestle in corals, the following passage from the "Gleanings" shows us land-crustaceans holding their own in the struggle for existence even against vertebrates:—"On Pitti Bank, which is a little uninhabited sand-cay of one of the most submerged of the Laccadive atolls, we found, at the end of November, 1891, vast swarms of a large species of sea-tern breeding. There were nestlings in every stage, but no eggs. Both old and young birds were quite free from fear, the old birds, almost alighting on our shoulders as we landed, and the young birds, even those with their first plumage complete, submitting to capture without any resistance. Dreadful havoc had been wrought among the young birds, chiefly by large Cœnobite hermit-crabs, with which the islet swarmed, but also to some extent by *Ocypoda ceratophthalma*. The young broods were simply huddled together on the ground, without any sort of nest, so that in the absence of the parents they were at the mercy of the crabs. Judging from the bones and sprouting quills that covered the ground, hundreds of young birds must have perished, and in several cases we saw recently killed bodies lying under a living mound of voracious crabs."

§ 'Bulletin Scientifique de la France et de la Belgique," Vol. 34, pp. 316–362, plates 17–18. (Paris, 1901.)

‖ Fishery Board for Scotland. 18th Annual Report, pp. 144–188, plates 5–8. 1900.

¶ "Annuaire du Mus. Zool. Acad. Impériale des Sciences de St. Pétersbourg." 1899, 1900.

* "Danmarks Stilling og Tilstand." Af H. J. Hansen, Dr. Phil. Part 2, 216 pages. (Kjöbenhavn, 1900.)

† 4to. 290 pages, 3 plates. (Calcutta, 1901.)

‡ Reprinted from the "Scientific Memoirs by Medical Officers of the Army, India." Part 12, pp. 35-76. 4to. (Simla, 1901.)

Conducted by M. I. Cross.

THE HELIOSTAT IN MICROSCOPY.—The microscopist who has never seen a microscope used in conjunction with a heliostat has yet to learn the possibilities and advantages of such a form of illumination.

Residents in the British Isles have a substantial excuse for not using the heliostat because of the uncertainty of getting bright sunshine at the time of working; still the intermittent occasions on which it could be employed would well repay them for their trouble.

Microscopists with leisure would find it more useful than those who have few opportunities of working in the day time, while those who live in foreign countries where continuous sunshine can be depended upon are strongly recommended to make trials of a heliostat.

Its advantage is especially indicated in the illumination by monochromatic light, for which purpose two right angle prisms of dense glass with about 1¼ inch face are necessary, with half a rapid rectilinear lens to concentrate the light upon the prisms and the remaining half placed to receive the spectrum as it emerges from the prisms.

The microscope should be placed at some distance, say 12 to 15 feet, from the prisms, the height of the heliostat being so arranged that the beam from it shall fall upon the microscope mirror. A strip of card should be set in front of the microscope on a level with the mirror, and the room darkened as much as possible, when it will be found, if the prisms are nicely adjusted, that a brilliant image of the spectrum is projected. By slightly moving the prisms or the microscope the exact wave length of light that is desired for the work in hand can be selected, and that wave length used for the examination or photography of objects. The brilliance of illumination secured under these circumstances is so great that light well into the violet end of the spectrum can be satisfactorily utilised, and the resolving power of objectives increased thereby.

No ordinary light filter passes light of one wave length or even approximately so; by means of a heliostat a far more exact result can be secured, especially when by the method named above, a spectrum measuring 20 inches or more in length can be obtained at the microscope mirror.

Those who work with a heliostat once will anticipate further sunny hours for improving their acquaintance with it.

LABELLING SPECIMENS.—It is often desirable when mounting specimens to have at hand some ready means of marking them for future identification. The so-called grease pencil for writing on glass, which may be had in various colours, and can be purchased from many opticians, is one of the handiest and neatest means, especially as the writing can be removed subsequently with a little warm water.

Another device where labels are not at hand is to pass the glass slip across the tongue, allow the dampness to dry, after which an ordinary pen and ink can be used for writing upon the portion so treated.

In the case of specimens mounted on cover glasses or slides, which it is required to identify after passing through various solutions, the following method is recommended:—

Mix into equal parts of egg, albumen and glycerine, sufficient lampblack to make a good black fluid; this may be used with a steel pen for writing on a cover glass or slide, after which the glass should be held over a flame until the characters are dry; glasses so treated will not lose identification marks if placed in solutions.

PHOTO-MICROGRAPHY WITH SIMPLE MEANS.—Workers with limited means are often tempted to make attempts at photo

micrography but are appalled by the number of fittings that are usually specified as necessary. It has to be borne in mind that it is not everyone who is bent on performing feats of resolution of diatoms or working with high powers; in making observations there are numerous enthusiastic amateurs, who, seeing a striking feature in an object, wish to record the appearance by photographing it for future reference or for the edification of friends. The bulk of such work would lie within the scope of 1″ or ½″ objectives, and many of the ordinary fittings of complete photo-micrographic cameras are not really necessary, however desirable they may be.

What is the simplest apparatus that can be used?

Being provided with a microscope and bull's eye, the additional apparatus would consist of an oil lamp, some form of camera, a support that will carry the camera at the axis height of the microscope when set horizontally, and a tube to connect the front of the camera with the body of the microscope.

1. *The Lamp.*—This need not be of an expensive kind such as is ordinarily supplied for microscopical work. One with a tin frame which is purchasable at an oil shop for 1s. answers very well. 2. *The Camera.*—This should not have less than 10″ of extension and requires to have a good dark slide with it. The focussing would, of course, be done by means of the microscope adjustments. 3. *The connecting tube* might be of cardboard or of brass as preferred. 4. *A support for the Camera.*—This is really of great importance in an arrangement of this description. It would be well that a frame should be shaped up by a carpenter to which the camera could be attached and on which, at a suitable level, the microscope and lamp could be placed in a fixed central position.

A knowledge of photography is so general that it is hardly necessary to say that an acquaintance with developing, printing, etc., is desirable; but with such contrivances as those named, carefully arranged, really good results can be secured with low-power objectives.

Success under such circumstances will lead to a desire to attempt more pretentious work with better apparatus. Photo-micrography has a charm of its own, but in order to attain proficiency it is essential that the worker possess a good practical acquaintance with microscopical manipulation and ordinary photography. The failures that are so frequently met with are due in the majority of instances to ignorance of one or both subjects, in fact, the writer has met with people who have essayed to do photo-micrography without previous serious work with the microscope or knowledge of its limitations. A serious practical man can succeed with elementary arrangements where a novice with the best equipment of apparatus would fail.

LOW-PRICED OBJECTIVES.—Perhaps in nothing so much as in scientific work is the fear present that anything that is low in price is likely to be poor in quality and yield corresponding results. But it can be claimed that this does not apply to microscopical objectives.

The past decade has seen a wonderful forward movement in the construction of these lenses. The almost general use of the microscope in laboratories, technical schools, for manufacturing purposes, and even in primary schools, added to the increasing recognition of its value as a means of recreation, has created a demand which has been at all times a critical one. There have always been the few who have been quick to recognise merit in lenses and to make their virtues known. Manufacturers have vied with each other, and by the use of the many optical glasses that are at their disposal, combined with extensive computations and experiments and skilful work, they have produced lenses of large aperture and fine performance. When apochromatic objectives were first introduced their performance was in the majority of cases immeasurably superior to others. These have been taken as a standard, and many lenses at very low cost are being made that are practically equal to them excepting only so far as the colour corrections are concerned.

It must not be inferred that this point is neglected, in fact it requires a critical eye oftentimes to detect an inferiority in this respect, but for the bulk of the work undertaken by microscopists it can be disregarded, and the cheaper lenses will reveal all that the apochromatics are capable of showing. These remarks apply to the products of nearly every firm of repute, and advice would be willingly given by such in the selection of lenses, which could be accepted without misgiving.

NOTES AND QUERIES.

J. E. S.—The reason why a condenser having a smaller aperture than that possessed by the objective is sufficient is because there are no lenses available that will bear an illuminating cone equal to their own aperture. As a rule definition begins to fail even with the best lenses when anything more than a cone of three-fourths the numerical aperture of the objective is employed. There have been exceptional lenses which have borne more than this, but they are rare. It would be well worth your while to have an oil immersion condenser if you were using an objective with a N.A. of 1·40. It is possible that this lens would stand a cone slightly in excess of 1·0 N.A., and the best dry condensers do not give much more than ·9 The cone of illumination required depends in a large measure on the subjects that are under examination; for a large amount of work a cone of ·9 would be quite sufficient for a lens of 1·40. Directions for the regressive staining method are contained fully in the "Microtomist's *Vade Mecum*," by Lee. Several pages are there devoted to the subject. The process could not be briefly described in these columns.

A. Glaister.—I am sorry to say that when the tubes containing the Infusoria you so kindly sent reached me, the contents were dead and quite disintegrated. It was therefore impossible for me to identify any of the specimens. Should you wish to send others, perhaps you would let me have advice a few days in advance so that I could arrange to receive and examine them promptly.

B. R. I. (Mysore Province).—When it is desired to show the contents of cells and vessels in woods, the sections must be cut, and mounted, dry. The best tools for making large sections of hard wood, are a carpenter's bench and a good plane. Longitudinal sections of almost any size can be cut in this way, and they can be trimmed up and the ends cut square with a pair of scissors. Then, if desired, they may be soaked in water and mounted in glycerine jelly. If the cell contents, viz., oils, turpentine, or resin are required to be shown, the sections must not be placed in alcohol because it would dissolve such contents; they consequently cannot be mounted in Canada balsam. I do not know of any microtome that will cut transverse sections of hard tissues of a large size. The one you refer to—Cole's pattern—is a very good one, but I am afraid that paraffin would not do for embedding, especially in India; a good firm piece of carrot is the only thing I know of. For instructions in staining and mounting, I would recommend Lee's "Microtomist's *Vade Mecum*," and for practical botanical histolgy Strasburger's "Practical Botany" (Swan Sonnenschein & Co.). I do not know of a book on entomology suitable for microscopists. The makers of lathes, etc., for grinding and cutting sections are Messrs. Cotton & Johnson, of 14, Gerrard Street, Soho, W., whom I have asked to send you a price list. A good practical work on the subject is "The Study of Rocks," by Rutley (Longmans).

Communications and enquiries on Microscopical matters are cordially invited, and should be addressed to M. I. CROSS, KNOWLEDGE *Office*, 326, *High Holborn, W.C.*

NOTES ON COMETS AND METEORS.

By W. F. DENNING, F.R.A.S.

ENCKE'S PERIODICAL COMET.—The re-detection of this comet is announced by Prof. Wilson, who saw it on August 6th, in the approximate position R.A. 6½°, Dec. 31° 43′ N., so that the comet was close to μ Andromedæ. The period of revolution being 3·3 years, the returns of this object occur at intervals of 33 years (10 periods), when the circumstances of its visibility are nearly the same as before.

COMET 1897, I. (PERRINE).—Dr. Johannes Möller has investigated the observations of this comet extending over the period from 1896, November 2, to 1897, April 29, and deduces hyperbolic elements. He finds the excentricity 1·000927, and gives a table in which is compared the orbital elements of seven other hyperbolic comets, viz.: 1844, III., 1886, II., 1889, I., 1890, II., 1892, II., 1898, VII., and 1899, I.

ERNST AUGUST LAMP.—Dr. Lamp, of Kiel, whose name is well known in connection with cometary investigations, died on May 10th, 1901, aged 51 years. Included in his valuable labours were a computation of the definitive elements of Comet 1891, I, and a discussion of the supposed connection, first pointed out by Mr. Hind, between Brorsen's Comet (1846) and Comet 1894, I. (Denning). He gave his conclusions on the latter subject in *Ast. Nach*, 3278, and showed that

the two comets made a very close approach to each other in January, 1881.

THE JULY METEORS.—The month was not altogether favourable for observation, temperature being unusually high accompanied with considerable mist. At Bristol the writer maintained a watch on seven nights, between the 15th and 24th inclusive, and saw 95 shooting stars in 14¼ hours of observation. The first certain indications of the great Perseid shower were noticed on the night of July 21st, when five meteors, of the usual rapid, streaky, indicated a radiant at about 23° + 52°. But the most interesting as well as the most active display of the period was from a point at 290° + 24° near β Cygni, which furnished some slow-moving trained meteors of a yellow colour. There was also well marked radiation from other points, and particularly from Capricornus, Delphinus, Cygnus, Andromeda, and Triangulum, but the meteors registered intimated a large number of feeble radiants rather than the special activity of a few. The most productive nights were July 20th and 21st, when meteors were fairly numerous, but on July 15th, 16th, 18th, 19th and 24th they were decidedly scarce, though the sky was favourable.

THE FACE OF THE SKY FOR SEPTEMBER.

By A. FOWLER, F.R.A.S.

THE SUN.—On the 1st the sun rises at 5.15, and sets at 6.45; on the 30th he rises at 6.1, and sets at 5.39. The sun enters Libra, and Autumn commences at 6 P.M. on the 23rd.

THE MOON.—The moon will enter last quarter on the 5th at 1.27 P.M., will be new on the 12th at 9.19 P.M., will enter first quarter on the 21st at 1.33 A.M., and will be full on the 28th at 5.36 A.M. The most notable occultation during the month is that of ε Tauri, mag. 3·7, which takes place on the morning of the 5th; disappearance at 4.2 A.M. at 123° from the north point (146° from the vertex); re-appearance at 4.58 A.M. at 221° from the north point (230° from the vertex).

THE PLANETS.—Mercury is an evening star throughout the month, but unfavourably placed for observation in northern latitudes.

Venus is also an evening star, but still unfavourably situated for naked-eye observations. Throughout the month the planet sets about an hour after the sun. On the 15th the apparent diameter is 13″·6, and the illuminated part of the disc 0·795.

Mars remains an evening star, setting about 8.12 P.M. on the 1st, and about 7 P.M. on the 30th. The path is from the south-eastern part of Virgo into Libra. On the 21st the planet passes about a degree to the south of α Librae. The apparent diameter diminishes from 5″·0 to 4″·6 during the month.

Jupiter may still be observed in the evening; on the 1st he crosses the meridian at 7.33 P.M. and sets at 11.21 P.M., while on the 30th he crosses the meridian at 5.45 P.M. and sets at 9.33 P.M. During the month the polar diameter diminishes from 39″·0 to 35″·6. The movement of the planet is easterly, through the western part of Sagittarius; in quadrature on the 28th. The principal satellite phenomena are as follows:—

		H. M.			H. M.
1st.—	I. Ec. R. ...	8 24·2	13th.—	II. Tr. I. ...	8 54
2nd.—	III. Oc. R. ...	7 46	15th.—	I. Oc. D. ...	8 42
	III. Ec. D. ...	9 34·9		II. Ec. R. ...	8 43·1
3rd.—	IV. Sh. I. ...	9 28	16th.—	I. Sh. I. ...	7 10
6th.—	II. Sh. I. ...	8 54		I. Tr. E. ...	8 10
	II. Tr. E. ...	9 12		I. Sh. E. ...	9 28
7th.—	I. Tr. I. ...	9 31	20th.—	III. Sh. I. ...	7 20
	I. Sh. I. ...	10 45	23rd.—	I. Tr. I. ...	7 47
8th.—	I. Oc. D. ...	6 49		I. Sh. I. ...	9 5
	I. Ec. R. ...	10 19·2	24th.—	I. Ec. R. ...	8 38
9th.—	I. Sh. E. ...	7 32	27th.—	III. Tr. I. ...	6 5
	III. Oc. D. ...	8 27		III. Tr. E. ...	9 13
11th.—	IV. Oc. D. ...	6 58	29th.—	II. Oc. D. ...	8 29
	IV. Oc. R. ...	9 28			

Saturn remains a few degrees to the east of Jupiter, setting on the 1st at 11.55 P.M., and on the 30th at 10.1 P.M. The planet has a slow westerly movement until the 14th, when it is stationary, and an easterly movement during the remainder of the month. On the 15th the major and minor axes of the outer ring are respectively 39″·8 and 17″·2, while the polar diameter of the ball is 15″·8. The northern surface of the ring system is presented towards the earth.

Uranus is in the southerly part of Ophiuchus, and may therefore be observed in the western sky for a short time after sunset. On the 1st the planet sets about 10 P.M., and on the 30th about 8.8 P.M. During the month the planet describes a short easterly path nearly midway between Antares and η Ophiuchi. The planet is in quadrature on the 6th.

Neptune is again coming into position for evening observations, the planet rising about 10.30 P.M. at the middle of the month, and being in quadrature on the 25th. During the month a short easterly path is described in the western part of Gemini. On the 14th, the planet is 3 minutes preceding and 15′ 20″ south of η Geminorum.

THE STARS.—About 10 P.M., at the middle of the month, Auriga and Perseus will be in the north-east; Taurus low down a little north of east; Aries, Andromeda, and Cassiopeia towards the east; Pisces a little south of east; Cetus low down and extending from east to south-east; Pegasus south-east; Aquarius and Capricornus nearly south; Cygnus almost overhead; Aquila and Lyra nearly south-west; Hercules in the west; Corona and Boötes to the north of west; and Ursa Major nearly due north.

Minima of Algol occur on the 1st at 7.36 P.M., and on the 21st at 9.18 P.M.

Chess Column.

By C. D. LOCOCK, B.A.

Communications for this column should be addressed to C. D. LOCOCK, Netherfield, Camberley, and be posted by the 10th of each month.

Solutions of August Problems.

No. 1.

(W. S. Branch.)

1. Q to R3, and mates next move.

No. 2.

(W. Clugston.)

1. R to Kt 5, and mates next move.

No. 3.

(W. H. Gundry.)

1. Q to QB8, and mates next move.

[There is unfortunately an alternative method by 1. Kt to Q6ch.]

CORRECT SOLUTIONS of the three problems have been received from J. Baddeley (6), H. Le Jeune (6), G. Groom (7), F. J. Lea, (6), G. A. Forde, Capt. (7), S. G. Luckock (6), W. de P. Crousaz (7), W. H. S. M. (7), C. C. Massey (6), Eugene Henry (6), G. W. (7), Alpha (6), G. W. Middleton (7), W. Nash (7), A. C. Challenger (7), W. Jay (7), Vivienne H. Macmeikan (6), F. V. Louis (7), C. Johnston (7), F. Dennis (7), J. E. Broadbent (7).

A. E. Whitehouse has solved Nos. 2 and 3 correctly, W. H. Boyes Nos. 1 and 2. C F. P. scores 4 points for the three problems, 2 being deducted for incorrect claims.

J. T. Blakemore.—No solutions received from you this month. Did you post them?

XUM

F. J. Lea.—Your solutions last month were too late to count.

G. A. Forde.—B × R will not solve No. 3. The Black Queen can give check. But as this is an incorrect claim for a third and not for a second solution, no points have been deducted.

W. H. S. M.—P to K3 is met by R × P. You nevertheless score 3 points for No. 3, for the reason stated immediately above. Correction to solution of No. 2 received just in time.

A. E. Whitehouse.—K to B2 exposes the White King to check.

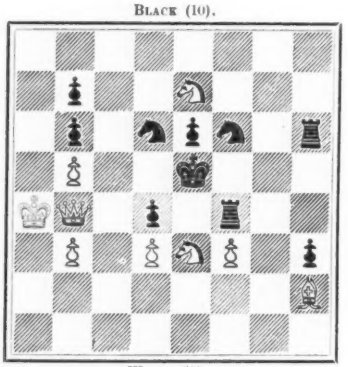
C. C. Massey.—Obviously the solution Kt to Q6ch was not intended by the composer. The solution to the June three-mover is, as was clearly stated in the July number, P × B, becoming a *Bishop*, not a "Knight" as you quote. But if the White Pawn were to become a Queen, then the *Black* Pawn would become a Knight, and stalemate would result.

PROBLEMS.

By C. D. Locock.

No. 1.

BLACK (10).

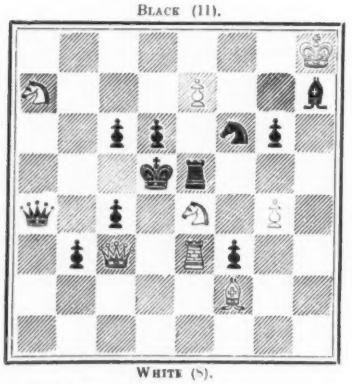


WHITE (9).

White mates in two moves.

No. 2.

BLACK (11).



WHITE (8).

White mates in three moves.

The following are now leading in the Solution Tourney:

Forty-five points.—C. Johnston, A. C. Challenger, W. Jay.

Forty-four points.—S. G. Luckock, W. H. S. M., G. Groom, F. Dennis, G. W. Middleton.

Forty-three points.—J. Baddeley.

Forty-two points.—H. le Jeune, W. de P. Crousaz, G. W.

Forty-one points.—W. Nash, J. E. Broadbent.

Forty points,—Vivienne H. Macmeikan.

Thirty-nine points.—C. C. Massey, Alpha.

Thirty-eight points.—G. A. Forde.

It will be seen that the number of those who have scored the maximum possible number of points is now reduced to three; but fifteen others follow them at very close intervals, and the competition is evidently reaching its most exciting stage.

The following is the solution of Mr. H. Wood's problem:—

Place the White Pawns at Q5, K5, KB5, KKt5, KR5, K6, KB6, and KKt6. Black's best methods of prolonging the game are—

(A) Kt to KR3; 1. KtP × BPch, Kt × P; 2. P × Ktch, K × P; 3. P to Kt6ch, P × P (best); 4. RP × Pch, K moves; 5. BP mates.

(B) QP × P; 1. P × PBch, K × P (best); 2. KtP checks, RP × P (best); 3. RP × Pch, K moves; 4. BP checks, K moves; 5. BP × P mate.

G. W. Middleton sends a solution, but with 9 White Pawns.

CORRECTION.—The composer of the "eight Pawns problem" has just discovered that Black has a satisfactory defence in 1. KP × BP, and that *nine* Pawns (the number postulaled by Mr. Middleton) are required for the purpose. As Mr. Wood himself justly remarks, this necessity for an extra Pawn deprives the puzzle of all its point.

CHESS INTELLIGENCE.

A match between Messrs. F. J. Lea and R. Teichmann was recently concluded at 37, King Street, Covent Garden, a former home of the British Chess Club. Mr. Teichmann proved victorious by 5 games to 2.

Many chess-players and others will learn with regret the news of the death of the Rev. J. Coker, of Tingewick, Bucks, at the age of 76. Mr. Coker was formerly captain of the Winchester College Cricket Eleven, and played also for Oxford University. As a chess-player he was well known at most of the meetings of the Counties Chess Association, where he was always a formidable competitor.

The final contest for the Southern Championship took place at Reading on July 20, when Surrey encountered Gloucestershire. In order to retain their title Surrey had not only to win the match, but to win it by a majority of at least 9½ to 6½, for reasons stated in the August number. With this object in view, Surrey put a very strong team into the field, and, though the scoring on the first six boards was quite even, they obtained a decisive majority on the remainder, and won handsomely by 11 games to 5. Mr. D. Y. Mills took charge of board No. 1 for Gloucestershire, and defeated the Surrey Champion, Mr. Herbert Jacobs.

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